

THE
Vse of both the Globes, Ce-
lestiall, and Terrestriall,
most plainly deliuered in
forme of a Dialogue.

Containing most pleasant, and pro-
fitable conclusions for the Mariner, and ge-
nerally for all those, that are addicted
to these kinde of Mathematicall
instrumentes.

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Written by T. Hood Mathematicall
Lecturer in the Citie of London,
sometime fellow of Trinitie Col-
ledge in Cambridge.



Imprinted at London at the three Cranes
in the Vintree, by Thomas Dawson.

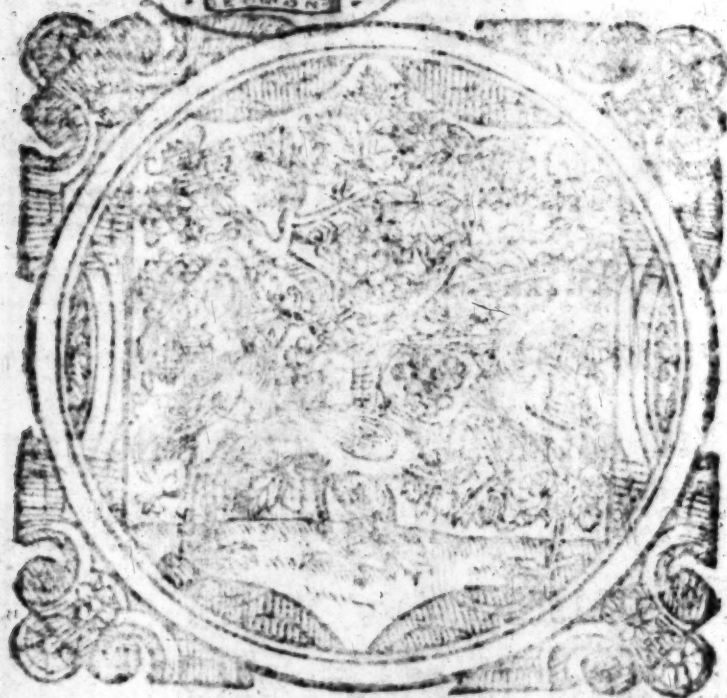
1592.

THE
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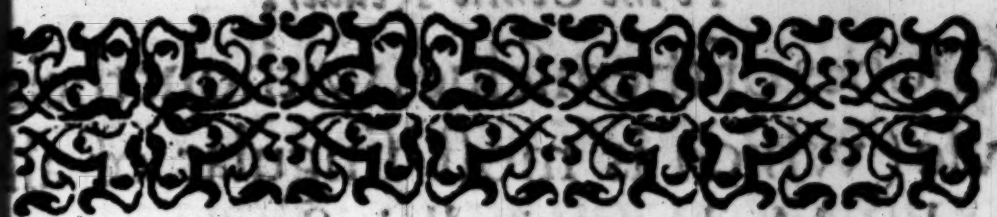
Containing most pleasant and profitable
conferences for the Mariner, and generally
for all those that are addicted
to the study of Astronomical
Influences.

Written by T. Hood Mathematicall

Lecturer in the
College in
London



Printed at London at the three Graces
in the Vineyard by Thomas Dawson.


To the Welwillers of the
Mathematicall Lecture T. Hood,
witheth all felicitie.

T is not vnknown
vnto you most friend-
lie and curteous audi-
tors, that the worship-
full *William Sanderson*,
besides the great coste, which hee
hath heretofore imployed in the
searching out of the Northwest
passage vnto *China*, and the *Moluccas*,
and to a relieued our countremen
(in *Virginia*) hath nowe of late with
no small charge for the farther ho-
nour and benefite of the common-
wealth, caused twoo Globes (the
Celestiall and the *Terrestriall*) to be set
foorth. And for somuch as the
A 3 Globes

To the Gentle Reader,

Globes of themselves without their
vse (which is most singular of all
other Mathematicall instrumentes)
are more delightfull to the eie then
profitable to the professor thereof,
he did with a friendlie consideratiō
inuite me to pēne this treatise cōcer-
ning their vse, the which I thought
good generally to dedicate to the
tution of you al, rather then to any
one (as the common vse is) in this re-
spect. I am crediblie informed of
late that certaine men, whereof one
(how profoundly soeuer hee thin-
keth of his learning) not being habile
ether to wright true English, or La-
tine, hath gone about to *form. an out*
rageous, and most impudent Pam-
phlet to my disgrace, & to commit
it to the presse, an other not beyng
habile ether to write or reade, run-
neth vp & downe, both the Court
and Citie (pretending I know not
what

To the Gentle Reader.

what skill in Mathematical matters) seeking to discredite al me in respect of him selfe; & me not modestly among the rest. Forso much therefore (most louing auditors) as these men and such like without any cause (except my well doing mooued them thereunto) haue gone about to *Kendell* a most vile conceit against me in your mindes: my request therefore vnto you all is this, that you will friendly and fauorably peruse this worke: and conferring it with the profite which you haue acknowledged in my reading, vouchsafe to be my patrones against such vnderferued ill willers of mine, and that so much the rather, because in this Booke I haue sette foorth certaine things, whereof I haue not had any direction from other authors, but haue grounded them vppon mine owne studie, and experience guided by

To the Gentle Reader:

by reason, which if it shal please you
to do, you shal finde me most wil-
ling, as I haue alwaies bin, to be pro-
fitable not to you onely priuately,
but to my cōmon wealth publike-
ly in what I may. Farewell.

Yours Thomas

Hood.

The vse of the Celestiall and Terrestriall Globe.

M.  Ll hayle *Philomathes*, what newes?
P. No newes Sir, but this is the cause of
my cōming, to haue a litle conference
with you touching the *Globe*.

M. You know that my mind, & affection towards
all men of honest disposition hath beene such, that I am
ready to pleasure them so farre forth as I may. Say there-
fore briefly, what will you haue the ende of our commu-
nication.

P. My desire is to be instructed by you in the vse of
the *Globe*: and that so much the rather, because lately
by our painefull countryman Maister *Mollineux*, at the
great cost and charge of that worshipfull gentleman, and
tutor of learning M. *William Sander son*, there haue bin
two Globes set forth, and for so much as they are now in
the handes of many with whome I haue to do, I would
not be altogether ignorant in those matters.

M. In good time *Philomathes*, is this requested at
my hands, for I my selfe haue beene very liberally inuited
to him to penne a Booke, concerning the vse of both the
Globes, for the better profite of our countrymen. So
that your request is but an hastening forward of that
worke, which in respect of his liberalitie I cannot but be
willing to vndertake. Goe to therefore let vs come to the
matter: and to the end your desire may be fully satisfied,
I shal propose you the question, and I will answere.

P. Very well: First resolve me in this, what differ-
ence do you put betweene a Globe & a Sphere. Me thin-
keth by the common phrased of speech there should be a

Of the Celestiall and

difference betweene them, for I heare some men say, that they will learne the vse of the Globe, and others are desirous of the Sphere.

M. If you regarde the proper signification of the worde, they differ nothing but this, that the one is the Greeke worde, the other the Latine. But in their vnproper signification there is a difference betweene them, for the Greeke worde *σφαῖρα*, as it is vsed vnproperly, signifieth that, which the Latine worde *Globus* cannot. The worde Sphere taken vnproperly betokeneth such a bodie as is rounde on the outside and hollowe within (as that which is made of twoo rounde dishes ioyned together by the brimmes) the which bodie the Latines properly call *Orbis*, an Orbe: in this sence also is the worde *Globus* vsed. Moreouer the word *Sphæra* signifieth that instrument made of brasen hoopes (wee call it commonly a ringed Sphere) wherwith the Astronomers deliuer vnto the nouices of that Science, the vnderstanding of things which they imagine in the heauen. In this sence wee cannot vse the worde Globe, except wee initiate the ignorant people who not knowing how to call a thing rightly, will now & then terme the ringed Sphere a Globe.

P. What is the proper signification of these words and how are they defined?

M. A Sphere or Globe, which in truth are all one is a round bowed Solide: such a one is the whole frame of the world consisting of heauen and earth;

P. What am I to obserue in this definition, for the better vnderstanding of the present matter which we haue in hande.

M. You are especially to note the worde (rounde

Terrestrial Globe.

and thereby to gather this, that whether the Globe be Mathematically conceaued in minde, or sensibly deliue- red to the eye, it is contained and inclosed ynder one sur- face. Also because nothing is made rounde without a centre, therefore in the midst of the Globe wee must conceaue a poynt to be, the which wee call the centre of the Globe, from whence all the right lines drawne vnto the vttermost surface of the Globe are equall. It is for so- much as the bodie cannot be made rounde without a circular motion, and there is no circular motion without some rest, and that rest cannot bee simplicie within the Globe, therefore likewise in the vttermost surface of the Globe you must especially obserue the two points vpon which the Globe mooueth, and vpon which it resteth whilest it is mooued. These points are called the Poles of the Globe. In the Poles this is to be noted, they are but two, they are right opposite one to another, they are e- qually distant from the Centre of the Globe. And in re- garde that the Globes (which we vse) represet some prin- cipall parts of the worlde, therefore we call these foresaid Poles, the Poles of the worlde and speaking eyther sim- ply of the Poles, or of the Poles of the worlde, wee haue relation onely to those pointes vpon which the Globe mooueth, whereof the one is termed the North, the o- ther the South pole. Last of all from the one Pole to the other wee must imagine a line to bee drawen through the Centre of the Globe, the which right line is called the axeltree of the Globe, which in the reuelution of the Globe neuer mooueth but standeth still. Thus much generally concerning those thinges which are to be no- ted in the Globe, so farre soorth as it is simplicie called by that name. Let vs now proceede to the diuision thereof.

Of the Celestiall and

The surface of the Globe, as wee haue hetherro spoken of it, is to be vnderstood as a blancke hauing nothing inscribed in it, yet fit to receiue any inscription: therefore according to the inscription of the Globe wee diuide it two seuerall wayes: so that the Globe is saide to be eyther Celestiall, or Terrestriall. The celestiall Globe is that which contayneth in the conuenitie thereof certaine circles of the heauen, and the fixed starres, with their Astronomicall appertinences. Of this Globe I minde God willing to intreat first, and then of the terrestriall Globe.

P. By your definition I perceauē that your whole discourse shalbe either of the circles belonging to the Globe, or else of the Starres with their Astronomical appertinences as you call them. But before wee enter into the discourse of these matters, I must craue a worde or two with you, concerning the particularities of your definition, that by comparing it with the thing defined, and with the thing signified by the Globe, which is the heauen, I may the better vnderstand the matter. First therefore in that you say that the Globe is rounde, would you haue me by these wordes vnderstande the Heauen to be so?

M. Yea that you must, & to confute that sonde opinion of *Lactantius*, who affirmed the Heauen to be flat, there are sundry arguments alleadged by the Learned, whereof some are probable, the other necessary, the arguments are these: First it hath pleased God in the forme of the heauen to set forth a resemblance of his eternitie, that as in this figure, so in him there is neither beginning nor ending. 2. For so much as the heauē was to cōprehende all corruptible things, & without it is neither time nor place, therefore it hath receiued a sphericall forme, which

Terrestriall Globe.

which of all Isoperimetrell figures is most capacious, and fittest to containe. 3. If the Heauens were not rounde, but three or foure square, or of some such like figure, that monstrous absurditie which nature doth so much abhorre, that is to say an emptinesse must bee graunted. 4. This roundnes being denied, it must needs follow, that wheresoeuer, and of what sorte soeuer the situation of the earth were, the distance frō it to the heaue would not be the same, so that the quantities of the same Starres & their distances would be vnequall to those that dwell in any one place of the earth.

P. And by your leaue Sir it seemeth so: who is he that hath not seene the full Moone to rise as bigge as a bushell, the which not withstanding being moued higher seemeth nothing so great. Againe in a fayre day, if wee looke rounde about vs, toward each part of the Heauen, doth it not seeme further frō vs neare vnto the ground, than ouer our heads? So that if we should make our eyes iudges of the roundenes of Heauen, wee can not auerre it to be so, because the Starres appeare in seuerall quantities, and each parte of Heauen seemeth not to be of an equall distance from vs.

M. In deed it is somewhat which you say but most easily answered, even by a familiar example. A man reading his booke seeth the quantity of each letter, & which way so euer he turneth himselfe keeping the booke in one distance from his sight the letters appeare of the same quantitie, but if he put on his spectacles he conceaueth the letter to be greater thā it is, because the visible forme thereof is enlarged by that meanes. The like must be vnderstood in the Starres, namely that which way soeuer they mooue they would appeare of the same magnitude,

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were it not that neare vnto the earth, when the Sunne is readie to set, there is a dampe or miste which is vnto our sight as the spectacles are, whereby the visible forme of the Starres scene is so enlarged and dispersed, that our sight cannot comprehend them in their proper Magnitude. The like vnto this is to be perceaued in the water, which caueth any thing cast into it to seeme greater, than it would appeare in the same distaunce lying on the bare ground. As for the seconde obiection which you make, you must vnderstand this, that the sight is not an immediate iudge of a distance assigned, but gathereth it by meanes, that is by the interposition of a certaine number of men or houses, or trees, or hilles, or some other such like thing betwixt the eye and the thing scene. Which thinges interposed if they bee many, wee affirme the thing scene to be farre off, because reason telleth vs that they cannot be contained in a small space: contrarywise if they bee fewe wee iudge the distance to be the lesser. Hereupon it commeth to passe that our eye running along by the ground and beholding so many houses, churches, hilles, and trees betweene vs and the heauen, wee iudge and affirme it to be farre from vs: but for somuch as in looking vp towards heauen, there is nothing to be scene directly in our sight, except a cloude or two which (as the Philosophers affirme) cannot be aboue three miles or there aboutes distant from the earth, therefore wee thinke that parte of heauen to be nearer: so that the argument taken from the equall apparent magnitude of the starres cannot bee but true, and inferreth the roundenesse of the heauen. The .5. argument is fet from the motion of the starres, which is circular. 6. Again the Spheri-

Terrestriall Globe.

All figure is fittest to mooue, and therefore moste
fite for the heauen, whose motion is continuall with-
out intermission. 7. Moreouer by the forme of the
partes namely the Starres, wee inferre the forme of the
whole. 8. Also this standeth with reason, that the
most perfect body should haue the most perfect forme,
and therefore the heauen beyng so pure and perfect that
the Philosophers wanting a name for the subiect mat-
ter whereof it is made, haue called it a Quintessence, it
requireth also the most perfect forme which is Spheri-
call and rounde, as may appeare by all the workes of
God, where in this roundenesse is especially to bee ob-
serued. 9. Last of all we may take an argument from
our Astronomickall instruments which are most fite be-
ing rounde and are deriued from a circle. Thus much
for the forme and figure of heauen.

P. You say then that the heauen is most perfectly
rounde: and not onelie that, but you will haue it also
to bee accounted a Solide bodie. By the worde Solide
we commonly vnderstand that bodie which beyng made
of some massie matter is not hollow within, but whole
and intire through out. Must I conceaue the heauen to
be so?

M. Common sence denieth that conceat. For you
see the earth, the water, and whatsoeuer element else,
or Elementate thing there is to be contayned within the
coape of heauen, in so much that the matter of the hea-
uen is not intire and Solide thorough out. But to the
ende you may vnderstande this Soliditie aright, hear-
ken I pray you vnto my wordes, and let the materiall
Globe alone for a while. The whole worlde is diui-
ded into two principall partes, the one Etteriall, the

Of the Celestiall and

other Elementall. The Elementall parte compacted of the 4. Elements, the fire, the aire, the water, and the earth is inuironed on euery side with the Etheriall parte which is the Heauen : which from the element of the fire vpperwarde is Solide and hath no emptines in any place. Yet it is not so Solide but that it is distinguished into certain Spheres or (as we ought properly to tearme the) Orbes whereof each one mooueth diuersly. These Orbes are in number. 10. as may be gathered by the motion, occultation, and parallaxe of the Starres. The 10. which is the vppermost of all is called the *primum mobile*, it mooueth from the East directly toward the West vpon the poles of the world, expressed by the poles of the Globe, within the space of 24. houres, and imparting his motion to the other. 9. it carrieth them with him rounde about in the same time, so that whereas we see the Sunne, the Moone, & all the Starres to rise and set within that space, it commeth to passe not by their owne proper and peculiar motion, but by the violent and swifte motion of this first moouable. The inferior. 9. Spheres mooue from the West toward the East not directly in a line against the other, but from the West Southwest they bende toward the East Northeast. Some of these. 9. Spheres are beautified with Starres the other haue none. The ninth Sphere hath neuer a Starre, it is vsually called the Crystalline heauen (although that name be common also to the foresayd Sphere) because it is most cleare, and transparent, hauing no one parte thicker than an other. It maketh his proper and perfect reuolution as *Ptolome* affirmeth in 36000. as *Albategnius* writeth in 23760 as *Alphonsus* gathereth in 49000. yeares : the which time is thought to be *Plato* his great yeare, wherein he sayd
each

Terrestriall Globe.

Each thing should returne to the former estate. Of those
spheres which are beautified with starres, some haue but
one starre, the other hath many: that which hath many is
the .8. Sphere, otherwise called the Firmament, either be-
cause beyng the vtermoſt of all (as antiquity iudged) it
firmly keepeth in & incōpasseth the rest, or else because
it cōprehendeth those starres, whose distance one frō an-
other is firme & fixed, and not vncertaine as the other
are, and therefore also is called the Sphere of the fixed
starres. This .8. Sphere albeit it be partaker of the .2. vp-
permoſt (for as I sayd each vppermoſt Sphere imparteth
his motion to all his inferiors) yet hath it a motion pro-
perly belonging to it selfe, not perfect and absolutely
sphericall, as the other motions are but winding from
the North to the Southward, in .3500. yeares it reuolueth
the same way in the same time, making his whole acceſſe
and reſeſſe in .7000. yeares. This motion is called the
motion of Trepidation. The other .7. Spheres which suc-
ceede are each one decked with one onely starre called a
Planet, that is by interpretation a wandring Starre; not
that it runneth at randon vncertainely, (for the motion
of them all is moſt certainly knowne, as may appeare by
the Eclipses which are foreſcene an hundred yeare be-
fore they come) but because their distance one from an-
other is neuer the same beyng, sometimes nearer, and
sometimes farther of, therefore are they termed wan-
dring starres. The vppermoſt of these .7. is the Sphere of
Saturne, whose motion is complete in .29. yeares. 155.
dayes. 3. houres. 47. min. 44. sec. *Iupiter* next vnder him
cōpasseth the Heauen by his proper course, in .11. yeares,
14. dayes. 13. houres. 12. min. 4. sec. The Sphere of *Mars*
finiſheth his race in one yeare, 321. dayes. 16. houres. 34.
min.

Of the Celestiall and

min. 44. sec. The Spheres of the sunne, *Venus*, and *Mercurie* run their course in one yeare, that is in. 365. dayes, 5. houres, 55. min. 26. sec. 10. thirds. 56. fourths. The which space of time is commonly called, a solare yeare. The *Moone* which is lowest of all & next to the Elementall region, maketh her reuolution in the space of. 27. dayes, 7. houres. 43. min. 7. sec. So that hereby you are to vnderstande that albeit both the heauen it selfe and the celestiall Globe be called a Solide bodie, yet there is this difference betweene them that the Globe consisteth of one peece, but the heauen of many Spheres or Orbes, and those as you haue hearde moouing fundry wayes & in diuers maners.

P. I doe beleue you because, as the Prouerbe is, a learner must beleue, but it seemeth vnpossible that the one Sphere should mooue one way, and the other another way.

M. It is no more impossible for the one Sphere to mooue one way and the other another way, than it is impossible for the Maister of a shippe to walke from the prow to the poupe, that is from the South Northward; whilst the ship runneth from the North Southward.

P. Which of all these, 10. Spheres doth the celestiall Globe represent?

M. It representeth especially the, 10. Sphere.

P. But you said before that the starres are in the 8. Sphere which is the firmament.

M. It is true: but because the motion of the fixed Starres following the motion of the ninth Sphere from West to East, is so slowe and so litle, that in a mans life tyme it can hardly be perceaued, therefore without any

great

great inconuenience we may place the fixed starres in the
face of the Globe, though it properly in respect of the
circles represent the tenth.

P. Why do you in the definition of the celestiaall
Globe put in these words (contayning in the couexitie)?

M. Thereby is expressed an other difference be-
tweene that which wee behold in the heauen it selfe, and
in the celestiaall Globe. Our eye not beyng within the
Globe beholdeth euery thing described thereupō on the
outside: whereas notwithstanding we see the starres on
the inner side of heauen.

P. Why doe you say certaine circles, are there any
more to be vnderstood in the heauen, than are expres-
sed in the Globe.

M. Yea a great many, the which I will both name
and describe vnto you as occasion serueth. But for so
much as these on the Globe are sufficient for a yong be-
ginner or a Nouice in Astronomie, therefore there are
no more described, Whereof one is Reall, the other are
Imaginarie.

P. What say you that some of these circles are ima-
ginarie, What meane you thereby, would you haue vs
thinke them to be deuises of an idle brayne?

M. Not so, their commoditie is singular in com-
mon life beyng well vnderstood and applied to vse: but
therefore they are called Imaginarie because they are not
expresse to be seene in the heauen, but are in minde to
be conceaued.

P. Well, let vs now come to those thinges which
you saide are principallie to be obserued in the celestiaall
Globe, that is the circles and the starres with their Astro-
nomicall appurtenances.

M. Here

Of the Celestiall and

M. Here I will vse a Hytleron proteron as the Rhetoricians tearme it, and will set the carte before the horse that is I will first speake of the Starres, and then of the Circles, for so I thinke it fittest for your instruction.

P. As you please Sir, but what Methode and order shall wee obserue in them.

M. I thinke it not amisse to haue consideration of these two thinges: First, of the writing which I tearme before the Astronomically appertenances, then of the starres themselves.

P. I pray you do so. I perceauie in the Globe that before many of the Starres there are set downe the Characters of the Planets, sometimes one alone, as in the thigh of *Gemini*, what doth it signifie.

M. The Character doth expresse the nature of the Starre vnto which it is adioyned, according as the Character doth importe. If it be the Character of *Saturne*, it signifieth the Starre to be of his nature: if it be the Character of *Iupiter*, it signifieth the starre to be of his nature, and so forth of the rest.

P. Sometimes there are two Characters together as in the fishe.

M. They betoken that starre to admit the nature of both the Planets.

P. Sometimes betweene the two Characters there standeth the letter P.

M. It signifieth the starre to be of the nature of the Planet vnto whom the first Character doth belong, yet partly also of the nature of the Planet, to whom the other Character apperteineth.

P. Sometimes the Characters are not ioyned with any one starre but are set downe by themselves alone, &

before

Terrestriall Globe.

fore the Character there stādeth a letter as in the Lion.

M. It signifieth that all those starres to whom that letter is adioyned, to be of the qualitie of that Planet, be-
whose Character the same letter standeth.

P. I finde in the Globe certaine syllables, but they
ake not perfect wordes: as *Card*, or *Car*, *Alf*, or *Al*.
Reg.

M. *Card*, or *Car*. signifieth *Cardanus*, whose stu-
in these sciences hath beene singular, and therefore his
thoritic is great, and is often alleaged not onely for the
gnesse of the Starres, as where it is written *Reg. Car*.
at is to say, *Cardane* counteth it a princely Starre, or a
starre of the first magnitnde. But also for their qualitie
where you see it written by the bowe of *Sagittarius*
the archer, the meaning is that *Cardane* accounteth that
starre to be of the nature of *Iupiter & Mars*. The like
to be vnderstood of *Alf*. or *Alfon*. which signifieth
Alphonfus king of *Aragon*, whose great trauaile and
st in those studies hath purchased vnto him an eternall
ame.

P. Let vs now come to the Starres for I see nothing
to be doubted of, what order shalbe kept in discour-
ing of them.

M. I thinke it sufficient to speake of their adiuncts,
namely of their quantitie and qualitie.

P. Then you minde not to speake of the diuision of
the Starres into seuerall kindes, nor of the matter where-
they are made.

M. No, for the starres expressed in the Globe are all
of one kinde, that is fixed, and differ onely in quantitie or
ualitie, as for the matter, that belögeth not to the Astro-
mer, but to the Philosopher: so that whether they be
the

Of the Celestiall and

the thicker parte of their Orbe, and are to their Orbe
as a knot to a tree, or whether they bee made of fire
or are fire stones let the Philosophers looke to that. I pro-
pose onely to entreate as I haue sayde of their quantitie
and qualitie. The quantitie of the starres is to be consid-
red eyther in their number, or in their magnitude.

P. How many are there in the Globe?

M. There are 1025.

P. Are there no more in the heauen? We say com-
monly that they are in number infinite.

M. It is without question that there are more
in the heauen, but yet they are not infinite in number, for
it is written. *Psalm. 147.* He counteth the number
of the Starres and calleth them all by their names. If they
may be counted and named, they are not infinite. There-
fore when wee say that they are infinite, our meaning
is that their number is exceeding great, as it appeareth. *Gen-
esis 22. vers. 12.*

P. Why then do the Astronomers keepe an account
of no more seing their number is so great?

M. The heauen is to the Astronomer as a booke
therefore euen as a man looking vpon a booke lying far
off from his sight, doth onely account those letters which
he doth see & discern: euē so the Astronomer, although
he see a great number of starres, yet maketh he account
of no more then these because he can distinguish no more.

P. Haue there no more beene noted heretofore,
since the time that this number was first ratified?

M. Yes, for the *Portugales* traveling into *India*
haue brought home newes of certaine litle cloudes new
vnto the South pole, & certaine stars, the which stars
you may see are set downe by *M. Mollineux* in the *Celestiall*

Terrestriall Globe.

terrestriall Globe. Some of them being comprehended within the Crosse, and are commonly by our men called the Crosses, some of them are included in the South triangle, others are left informed. So that their report argueth that all the fixed starres were not obserued by Ptolomie himselfe.

P. There is yet one question remaining touching the number of the starres. I obserue that in the winter the number of the starres seemeth more than in Summer: what should be the reason thereof?

M. You must note this that it most commonly falleth out so when the weather is coldest, and the nightes are frostie: and thereby I gather the chiefest reason, why in the winter the starres appeare so many to bee this, in Sommer the colde hauing no place left vnto it where-to be, but the middle region of the ayre, where it waxeth at that time most forceable by reason of the An-peristasis of the heate, it so engrosseth and thickeneth the ayre, that the starres of the lesser magnitude beyng but weake in their beames cannot pearse it, and come to our sight: In winter this colde breaking the prison wherein it was pend before, & gathered thicke together, spreadeth it selfe and becommeth more thinne, so that the ayre beyng more purged, and the grossenes thereof being taken away, yeeldeth to the starres of smaller light, a free and readie passage through which they may sende their beames vnto our sight. An other reason is thus alleaged, in winter because the ayre is more purged, the starres do shine very forceably, whereupon it cometh to passe that our sight may be deceaued in them, and causeth vs to thinke, that wee perceauie more starres than indeede wee see doe: where as wee doe not see more starres, but
only

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onely certaine appearances of them procured by their vehement brightnes and twinkling, and by the waue-
ring of the ayre. Let this also be an other reason: the nea-
rer the Sunne is to the ground the more lightsome is the
ayre about it, the more lightsome the ayre is the fewer
Starres are seene: therefore considering that in Summer
the depression of the Sunne is but litle, and in winter
great, whereby the ayre in the night time in Summer
is more lightened than in winter, herevpon it commeth
to passe that the starres seeme fewer in Summer than in
winter.

P. Thus much for the number of the starres: what
is their Magnitude?

M. Their Magnitude is a certaine quantitie where-
by the starres differ one from an other. The severall Mag-
nitudes obserued in the starres are sixe, vnto the which
are adioyned certaine other which are called of the La-
tines *Nebulosa*, & *Obscura*, cloudie and obscure or
darke starres. All there Magnitudes are expressed in the
Globe, with severall formes set downe before the nose of
the Greater Beare, so that hauing an eye to those formes
you may easily learne what Magnitude any starre hath
that is placed in the Globe.

P. How many starres are there of each severall Mag-
nitude.

M. There are, 15. of the first Magnitude: of the se-
cond 45. of the third 208. of the fourth 474. of the fift. 217.
of the sixt 49. The cloudie starres are. 5. the obscure. 9.
But you must still remeber this, that in this account those
starres are not contained which are inscribed in the Globe
according to the report of the Portugals, yet their seue-
rall Magnitudes may be knowne by their forme.

P. So

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P. So I suppose, but yet these which you have now accounted make but 1022. you reckoned before 1025.

M. It is true: but you must note this, that commonly in rehearsing the number of the starres, the Astronomers omit those which are in the haire of Berenice, if they be added the whole number is 1025.

P. Of what bignesse may the starres be?

M. Some of them are 107. some.90. some.72. times bigger than the earth. But of this matter I have written largely in my Booke concerning the vse of the Celestiall Globe in *Plano*, wherein you may satisfie your selfe concerning their quantitie.

P. The nexte thing to be spoken of touching the starres is their qualitie: what haue you to deliuer concerning that?

M. This worde qualitie hath a very large signification, and may be applied almost to what soeuer is not of the substance of the Starres. But I will speake onely of their twinckling and figure.

P. What is the cause why the starres do twinckle?

M. The continuall motion of the aire: in which there are two motions to be considered: the one is proper to the aire, which is vpward in a right line: the other is vnproper receaued from the Heauens. For as the Heauen is caried about in the space of 24. houres, so doth it lead with it what soeuer is moueable within it, whereby it commeth to passe, that the forme of the Starres appearing in it is greatly distracted, so that it seemeth to vs to cast forth sparkles, which we call the twinckling thereof. This may easily be confirmed by the water which running on swiftly causeth the Starres which are by reflexio scene in it, to twinckle much more than they doe in the

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aire, by reason that it is a grosser bodie, and the motion thereof is to vs more sensible than the motion of the aire.

P. If the motion of the aire be the cause of the twinkling of the Starres, why should not the Planets twinkle as well as they?

M. The reason why the Planets do not twinkle is their nearenesse vnto vs, whereby it commeth to passe that their beame is lesse troubled and distorted.

P. Doth the twinkling of the Starres signifie any thing?

M. It doth signifie the motion of the ayre generally: but if it bee more than vsuall it signifieth winde. Thus much concerning that matter, now followeth the figure of the Starres. The figure is eyther common or peculiar. The common figure considered in euery one is the roundenesse, for this wee holde that the figure of euery Starre is rounde, and not three or foure square: of this there are sundrie argumentes. First, our sense which iudgeth the Starres to be rounde: and gayne the most noble bodie as I saide before requireth the most noble forme: the most excellent bodies are the heauenly bodies: therefore they craue a rounde figure for that of all other is counted most excellent. To conclude the Moone geueth vs a most certaine argument of this roundenesse: for she doth not onely appeare so at the full, but at all other times she receaueth her light circularly from the Sunne.

P. Yet that is not alwayes so, for in the first quarter and the thirde her light is parted with a right line.

M. The reason of that is yeilded by the Maisters of Perspective, who truly affirme that euery great circle

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in a Sphericall bodie standing full before our sight, seemeth to be a right line, This therefore shall serue for confirmation of the common figure belonging to euery Starre, which is their roundenesse. The peculiar figure is that which is considered but in some, and is called a Constellation.

P. What is a Constellation?

M. A Constellation is a certaine number of starres representing by there place, & order (after a certaine sort) the forme of some naturall, or artificiall thing. It is otherwise called an Asterisme, forme or figure.

P. Are all the stars inclosed within these constellations?

M. You may easily see by the Globe they are not: there are, 108. excepted by the ancient Astronomers which are called (informes) vnformed, yet of later time, 6. of the same haue beene reduced into the figure of *Antinous*, and three into the haire of *Berenice*.

P. Why were the starres brought into constellations?

M. For instructions sake: things cannot be taught without names: to giue a name to euery one, had beene both troublesome for the Maister and for the Scholler: troublesome for the Maister to deuise, troublesome for the Scholler to remeber. As the merchant therefore catcheth all his billes of one kinde into one boxe: & out of that boxe can fetch them as occasion serueth: even so the Astronomers haue reduced many starres into one Constellation, that thereby they may tell the better where to seeke them, and being founde how to expresse them.

P. Why did they bring them into these figures and not into none other.

M. There be. 3. seuerall reasons which induced them therunto. First these figures expresse some properties of

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the Starres, as those of the Ramme to be hore, & drie, so is the Ramme: *Andromeda* chained betokeneth imprisonment. The head of *Medusa* cut of signifieth the losse of that member. *Orion* with his terrible, & threatening gesture importeth tempest, and terrible weather: the *Serpent*, the *Scorpion*, and the *Dragon*, signifie poison: the Bull insinuateth a melancholic passion, the Beare inferreth crueltie &c. Secondly some of the Starres if not precisely, yet after a certaine sorte do represent such a figure, and therefore that figure was assigned them: as for example the Crowne both North and South, the *Scorpion*, and the *Triangle* partly represent the figure which they haue. The thirde cause was the continuance of the memorie of some notable man, who either in regarde of their singular paines taken in Astronomie, or in regarde of some other notable deede, had well deserued of mankind, as *Hercules*, *Perseus*, &c.

P. Are these constellations of any antiquitie, & who was the first author of them?

M. I neuer reade who was the first author of each particular constellation, we receaue them of *Ptolomee* and he receaued them of the *Platonickes*, so that the antiquity is great. *Thyestes* the brother of *Atreus* is said to haue invented the constellation of the Ramme: Moreover in the 38. chapter of *Iob*, there is mention made of the *Pleiades*, *Orion*, and *Arcturus* & *Mazzaroth* which some interpret the 12. signes: *Iob* liued in the time of *Abraham* as *Siderocrates* maketh mention in his Booke, *De commensurandis locorum distantijs*.

P. How many constellations are there, and which are they?

M. There are 48, besides the Crosse & the South
triangle

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angle, which are newly added in the last Globes. In the
 North parte there are, 21. namely. 1. *Ursa minor*, the less
 Beare. 2. *Ursa maior*, the greater Beare. 3. *Draco*,
 the Dragon. 4. *Cepheus*. 5. *Bootes* or *Arctophylax*. 6.
Corona Borea, the North crowne. 7. *Ergonafix*, the
 sceler. 8. *Lyra*, the Harpe. 9. *Olus*, the swanne. 10. *Cas-*
peia. 11. *Perseus*. 12. *Heniochus* or *Harpa*, the
 ster. 13. *Serpentarius*, the man holding the Serpent.
Serpens, the Serpent. 14. *Sagitta*, the Arrow. 15. *Aquila*,
 the Eagle. 16. *Delphinus*, the Dolphin. 17. *Equis-*
fax, the lesser Horse. 18. *Pegasus*, the winged Horse.
Andromeda. 21. *Triangulus*, the Triangle. p. 101
 In the Zodiacke of the Sphere or firmament there
 are 12. according to the number of the Signes. 1. *Aries*,
 the Ramme. 2. *Taurus*, the Bull. 3. *Gemini*, the Twinnes.
Cancer, the Crabbe. 4. *Leo*, the Lion. 5. *Virgo*, the
 Virgin. 6. *Libra*, the Ballance. 7. *Scorpius*, the Scorpion.
Sagittarius, the Archer. 8. *Capricornus*, the Goate.
Aquarius, the Waterman. 9. *Pisces*, the Fishes.
 In the South parte there are, 19. 1. *Cetus*, the Whale.
Orion. 2. *Fluvius*, the River. 3. *Lepus*, the Hare. 4. *Can-*
is maior, the greater Dogge. 5. *Canis minor*, the less
 Dogge. 6. *Argo navis*, the Ship. 7. *Hydra*, the Snake.
Crater, the Cup. 8. *Corvus*, the Crowe. 9. *Centau-*
rus, the Centaure. 10. *Lupus*, the Wolfe. 11. *Lars*, or *Arct-*
urus. 12. *Corona Austrina*, the South Garlande.
Piscis Notus, the South Fish. p. 102

P. Yet me thinketh there be 2. which you have not
 named, that is *Antinous* and *Berenices haire*.
 Those two were dimmed since, and therefore are
 not vsually counted in the number of the Constellations
 but are reckoned among the informed Spheres. As I said
 before,

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P. Doe all Astronomers retaine these constellations and this number?

M. No, some count but .44. some .46. some .52. some 72. But by the chiefeſt Astronomers the foresaid number is retained.

P. Of which of all these Starres ought I to take notice especially?

M. It is good to know them all, or at leastwise those which are of the first, second, and thirde Magnitude. But you must especially bee acquainted with the lesser Beare: for the Starre which is in the ende of her tayle is called the Pole Starre, by reason of the nearnesse thereof vnto the Pole, it is also called the North Starre, and for the excellent vse, which it hath in Cosmographie, it is called simpliciter the Starre. And the North pole in respect of the nearnesse of the lesser Beare, is called the pole Arcticke (for *Arctos* among the Grecians signifieth a Beare) and the South pole because it is opposite, and right against the pole Arcticke, called the pole Antarticke.

P. I coulde wishe (if it were not troublesome) that you would deliuer to mee the poeticall reasons of these constellations because it is very pleasant.

M. It shall not neede if you desire them, you may finde them set forth at large in that little booke which I named before called the vse of the Celestiall Globes Plano.

P. Well then let them passe, and let vs now come to the Circles of the Globe, and in them I would gladly learne these two thinges, what they are, and what vse they haue.

M. With a good will; but first you must not

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the manifolde signification of the worde, otherwise you may mistake your selfe greatly. The worde Circle is taken sometimes properly, sometimes vnproperly. Properly a Circle is a rounde plane as *Ramus* defineth it, or according to *Euclide*, it is a plaine figure contained vnder one Line, which is called a Circumference, vnto the which all righte lines drawn from the Center are equall one to an other. In this sense wee neuer simplie vse the worde Circle, speaking of the Celestiall Globe, but wee vtter it periphrastical in this manner, the plane of the Equinoctiall Circle, the plane of the Horizon, or Horizontall circle, &c. The worde Circle taken vnproperly, signifieth eyther a circumference which is a crooked line without breadth, or else it signifieth a surface, in both these significations, the worde Circle is vsed in the Celestiall Globe: be they perfectlie rounde or no, whereupon we make this diuision of the Circles in the Globe: The Circles are eyther perfectlie rounde or vnperfectlie round.

P. Is it possible that there should be a circle in the Globe that is not perfectly rounde?

M. Doe you not see in the Globe a space contained and inclosed on each sides with prickles, which hath certaine diuisions and goeth not on directly, and euen as the other circles doe.

P. Yes, it passeth by the bowe of the Archer, and from thence ascendeth to the Eagle, and so continueth to the Swanne, and to Cassiopeia, and downe to the Archer, compassing the whole heauen round about: what may that circle be?

M. It is that great white circle which is really to

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be feene in heauen, by the Grecians it is called *Galaxia* by the Latines *Lactea via*, or *Lacteus circulus*, and by vs expreffing word for word, it is called *the milke way*. The beft opinion touching this circle is this, that it is the parte of the firmament, neither fo thinne as the other partes thereof, nor yet fo thicke as the Starres thefelues. If it were fo thinne as the other partes of heauen then could it not retaine any light, but the light would paffe through it, and not be feene: if it were as thicke as the Starres then would the light be fo doubled in it, that it would glifter, and shine as the Starres themfelues doe, but beyng neither fo thinne as the one, nor fo thicke as the other, it becommeth of that whitenes which we fee. If you defire to reade the poetickall fables or other discourses touching this circle, you fhall haue them alfo in my booke of the Globe in Plano.

P. What vfe hath this circle in the heauen?

M. Firft, it limiteth the tropicall points whereof we fhall fpeake hereafter: Secondly, it is an argument vnto vs to prooue, that the Starres mooue not in the firmament, as fifhes in the fea, or as birdes in the aire: For if that were fo, it is moft certaine that the Starres which are in this Circle at this prefent, would prefently fhifte the fame, and paffe out of it into fome other place of the Sphere which neuer falleth fo out: but common experience witneffeth this, that the Starres which are now in the milke way, haue bene in it euer heretofore, and wee fhall fee them ftill continue therein, fo long as the heauen indureth. Thus much for the vnperfect real circle which is but one. Let vs now come to the perfect circles of the Globe, which are not really to be feene but in imagination to be conceaued, vpon which the principall vfe of the

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The Globe dependeth: A perfect round circle is that which lieth vniformally betweene his termes. In these circles this is first to be noted, that vnto euery one of them belongeth Poles, and Graduation either expressely vnderstood. The Poles of a circle are .2. points concealed in the surface of the Globe, equally distant from euery parte of that circle whose Poles they are sayd to be. Graduation is the diuiding of a circle into certaine partes, wherof euery one is called a degree. The partes wherinto euery circle of the Globe either is actually or imaginably vnderstood to be diuided are 360. Therefore a degree is nothing else but the 360. part of a circle. So that when we speake simply of a degree either of heauen or earth, or generally of a degree of any circle, it is not to be vnderstood as a thing, that may be limited, and set downe by any certaine measure, as by paces, or yarges, or miles, or inches, or such like quantities, because it is not of a certaine greatnesse euery where, but as the circle is greater or lesser, so doth the degree increase or decrease, and is vnderstood to be the 360. parte of it, be it of what quantitie soeuer.

P. I praye you let vs wade a litle farther into this matter, tell me what was the reason why a circle was diuided into these partes and not into any more or lesse?

M. The reason is this. The Cosmographer whether he haue to deale with heauen or earth, hath many occasions to diuide a circle into sundry partes, therefore it behooued him to choose such a number in the diuision of a circle, as might most conueniently be diuided by many diuisors: now for so much as there could no number be founde of so small a quantitie, that might be diuided by
so

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so many diuifers as this number. 360. may be (for it may be diuided by. 1. 2. 3. 4. 5. 6. 8. 9. 10. 12. 15. 18. 20. 24. 30. 36. 40. 45. 60. 72. 90. 120. 180.) therefore they made a speciall choise of this number, reiecting the custome of *Eratosthenes* and *Hipparchus*, whoe were wont to diuide a circle into. 36. partes. Neither doe the Cosmographers onely graduate a circle, diuiding it into simple degrees, but they goe on farther and parte a degree into 60. minutes, a minute into 60. secondes, a seconde into 60. thirdes, a thirde into 60. fourthes, and so forth vntill they come to tenthes beyonde which number they doe not lightly passe.

P. Then I gather by your wordes, that a minute is nothing else but the. 60. parte of a degree, and a seconde is the. 60. parte of a minute, and a thirde is the. 60. parte of a seconde, and a fourth is the. 60. parte of a thirde, &c. But why did they choose this number. 60.

M. The Cosmographer was induced to choose this number. 60. by the same reason whereby hee was moued to choose the foresayd number. 360. As in diuiding of a circle so likewise in diuiding a degree, a minute, a seconde, &c. He thought it most conuenient to take such a number as beyng but small might be diuided into most partes, and therefore to auoide the tediousnesse of greater diuisions, he choose. 60. rather than any other, because there is none of so small a quantitie, that will admitte so many partitions for these numbers may diuide it. 1. 2. 3. 4. 5. 6. 10. 12. 15. 20. 30. Thus much concerning the significations of the worde circle, and the common accidents thereof, which are Poles and Graduation, now I will proceede to their seuerall kinds. The perfect rounde circles imaginarily conceaued in the
heaven,

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heaven, and adscribed with the Globe, are eyther great
or little. A great circle is that which cutteth the Globe
into two equall peeces. As touching the Poles of the
great circles this rule is generall, that if 2. great circles
cut one another at Right angles, the Poles of the one
circle are in the other: also, if 2. great circles cut one
another at oblique angles, the Poles of the one are di-
stant from the Poles of the other, so farre, as the great-
er declination or distance of the one circle is from the
other. A great circle is eyther moouable or fixed.
A moouable circle is that, which mooueth with the
motion of the Globe. A moouable circle, eyther li-
eth betweene the Poles of the Globe, or passeth thro-
ugh them: The moouable circles, which lie betweene
the Poles, are 2. whereof the one lieth iust betweene
them in the very middest, and is called the Equinoctiall
or Equator. So that the Equinoctiall may bee defined
to bee a great moouable circle of the Globe, lying
iust in the middest betweene the 2. Poles of the world:
The other circle lyeth not iust betweene the 2. Poles,
but leaneth towarde eyther of them, and is called the Ec-
lipticke, so that the Eclipticke may be defined to be a
great moouable circle, leaning towarde each pole of
the worlde, alwaies cutting the Equinoctiall at oblique
angles. The two points wherein it cutteth the Equinocti-
all are called the Equinoctiall pointes, and the two points
wherin it swarueeth most of all from the Equinoctiall, are
called the Solstitiall points, or Tropicall points, the reason
wherof I will declare hereafter. The moouable circles pas-
sing through the Poles of the Globe are 2. and they cut
themselves at Right angles in the Poles: the one is called
the Equinoctiall colour, the other is the Solstitiall colour.

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The Equinoctiall colour is a moueable great circle draw
by the Poles of the world & the equinoctial points. The
Solstitiall colour is a moueable great circle, passing thro
rough the Poles of the worlde, and the Solstitiall points.
A great fixed circle, is a circle which followeth not the
motion of the Globe, but standeth still whilst it turneth
about. The fixed circles are .2. cutting one another at
right angles, namely the Horizon, and the Meridian.
The Horizon is a great fixed circle of the Globe, diu
ding the parte of the heauen which is seene, from that
parte of the heauen which is not seene. The Meridian
is a great fixed circle of the Globe, cutting the Horizon
at right angles. Thus are all the perfect great circles ex
pressed in the Globe. A litle circle is that which diu
deth the Globe into 2. equall peeces, and are all equally
distant to the equator. The litle circles of the Globe ey
ther touche the Eclipticke, or are seutred from it. Those
which touche the Eclipticke, are called Tropickes. A Tro
picke is a litle circle in the Globe, parallell to the Equi
noctiall, touching the Eclipticke in the Tropicall point.
Those litle circles, which touche not the Eclipticke, are
called Polare circles. A Polare circle is a litle circle in
the Globe Parallell to the Equinoctiall, passing by the
Poles of the Eclipticke. Thus haue you the brieue defi
nitions of the vsuall circles of the Globe, the other cir
cles shalbe defined as occasion serueth.

P. I pray you, now let vs draw neare to that, which
I so greatly desire, that is the vse of the Globe.

M. The vse of the Celestiall Globe is eyther simple
or mixte. The simple vse of the Globe, is when we worke
and performe, a conclusion by the Globe it selfe, without
the helpe of any forraine instrument: and that either by
each

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each circle alone, or by two or more of them taken together. The mixt vse of the Globe is that, which be-
le the Globe requireth the vse of forraigne instruments,
and, for so much as these seuerall vses of the Globe can-
not so be distinguished one from another, but that of
necessitie now and then they must goe ioynedly together;
thinke it not a misse therefore before I goe any further,
to make you acquainted with the instruments.

P. Doe so I pray you, and I will mooue such que-
stions concerning them, as I shall thinke conuenient for
my instruction.

M. The instrumētts are these: First a paire of Calai-
ber cōpasses, whose feet must be bent inward according
as you see in the figure. *A.* The second is a Square with a
diuident line, made in such forme as you see the figure *B.*
The third is an houre circle as wee call it, with his In-
dex, expressed in the figures *C.* and *D.* The fourth is a
thinne ruler of braske, bowed according to the conuexi-
tye of the Globe, & diuided into the 90. degree, made fast
at the 90. degree to a litle buttone of braske, this instrū-
ment is called, the Quadrant of Altitude, and is expres-
sed in the figure *E.* The fifth is an halfe circle of braske
called a circle of Position, as in the figure *F.* The sixth
is an Index, which wee call a Sphericall Gnomon, the
forme whereof is expressed in the figure *G.* The se-
uenth is a Needle touched with the Load stone.

P. To what end serue the Calaber compasses?

M. With them wee take the distance of any two
things what soeuer propounded vpon the Globe, as of
two Starres, or of any circle from a Starre: or of 2. circles
one from an other.

P. In what manner shall I take the two starres, and
how

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how shall I inferre their distance.

M. Stretch the one foote of your compasse from the centre of the one Starre, vnto the centre of the other, then applie the feete of your compasses to the Equator, the degrees of the Equator contained between the feete of your compasses, expresse the distance of the two Starres.

P. But what is that distance?

M. It is their distance onely in degrees, for we cannot simplie expresse it otherwise, yet if you desire for your pleasure sake to knowe what number of miles any two starres in the Globe are distant, one from an other, note these my wordes and you shall know it. The Astronomers considering the huge quantitie of the starres compared with the Globe of the earth, haue concluded the compasse of the firmament to be in the outside 1017562500. miles, and each degree to containe 2826562½. Therefore knowing how many degrees any 2 Starres are distant one from an other, if you multiplie the number of degrees by the number of miles answerable to each degree, you shall finde the distance in miles, the centers of the 2. starres beyng supposed to be in the conuexitie of the firmament.

P. I pray you giue me leaue to haue a litle more conference with you concerning the taking of the distance of any two Starres, or what soeuer thinges else vpon the Globe. You say, that I must stretch the one foote of my compasses from the centre of the one starre vnto the centre of the other, and afterwarde applie my compasses to the Equator, the degrees of the Equator containd betweene their feete expresse how many degrees the two Starres assigned are distant one from an other

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her. I take this rule to be certaine and true, when the foote of the compasses beyng set in the beginning of a degree, the other foote lighteth iuste in the ende of the same, or of some other degree. But put case that the foote of the compasses should fall betweene the beginning, and ende of a degree, what shall I then say?

M. You must pronounce the Starre to be distant (besides the whole degrees) so many minutes, as are comprehended betweene the beginning of the last degree, and the under foote of your compasses.

P. But how shall I know how many minutes they are?

M. This question was conueniently mooued by a *Philomathes*, & giueth me occasiō to deliver vnto you a rule, whereby not vpon the Globe onley, but vpon your Astrolabe also, or any such like Mathematical instrument, you may find out, how many minutes there are contained about the whole degrees, in this manner. When the foote of your compasses lighteth betweene the beginning and end of any degree, make a pricke, where the said foote lighteth: then take the distance betweene the beginning of the last degree, & the pricke, & count it (beginning at which degree you please, and noting well where you begin) in the Equator. 60. times. The number of the degrees comprehended betweene the place where you first began your account, & the place wherein you finished the same, expresse the number of minutes contained in the said space. As for exāple put case that the space comprehended betweene the beginning of some one degree, and the pricke made in the same degree, being counted. 60. times in the Equator do runne ouer. 30. whole degrees of the saide circle, then must you pronounce, that space to
compre-

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comprehende.30.minutes. If beyng counted.60. times reacheth but vnto.15.degrees, then doth the saide space containe.15. minutes, if it ouerrunne.45. degrees, the doth it answere to 45.minutes, &c.

P. I vnderstand you well. But againe suppose the the space contained betweene the beginning of the degree, and the pricke therein be so litle, that I cannot take it with my compasses, because (as it may fall out) their secte will not come close enough together: How shall I then know, how many minutes are contained in that small space.

M. When it happeneth so, that you cannot take the space betweene the beginning of the degree & the pricke then take that space which is contained betweene the pricke, and the latter ende of the degree. Count that.60. times in the Equator marking how many degrees you doe runne ouer, subducte the number of those degrees from.60.the remainder sheweth you, how many minutes were comprised in the small space aforesaid. This also to be noted, that as you finde out the minutes, so may you finde the secondes and thirds, &c. of a degree. For if (the small space aforesaid beyng counted.60. times in the Equator) the foote of your compasses doth not light precisely vpon the ende of some degree, then take the space betweene the last pricke made with your compasses and the beginning of that degree, wherein that pricke is made, count it.60.times in the Equator, as you did the other before, the number of the degrees, which you runne ouer, expresse the secondes, &c.

P. In this thing also I conceaue your meaning, let vs proceede. Is there any thing to be obserued in taking the distance betweene two circles of the Globe, or between

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betweene some poynt assigned in the Globe, and a circle?

M. Yea, that there is, for you must take heed of this, that setting the one foote of your compasses in the one circle, you doe but touch the other circle with the other foote: for the distance betweene two circles assigned, or betweene a point, or starre, and any circle is the shortest extension that may be: now the shortest extension from circle to circle, or from point to point is, when the feete of your compasse (standing in the one circle) cut not the other in two severall places, but touche it in one only.

P. To what vse serueth the Plummet line?

M. It serueth to set the Globe vpright, which in some conclusions is necessarily required.

P. Vnto what parte of the Globe must it be applied?

M. It is most conueniently applied to the Horizon.

P. Vnto how many places of the Horizon must I apply it?

M. You must apply it vnto .3. severall places at the least, for setting it but in two you may chaunce to be deceived.

P. The third instrument which you spake of is the houre circle, of what quantitie is it to be made?

M. The quantitie according to the vsuall manner is at your owne pleasure, respect beyng had to the quantitie of the Globe. The greater Globe may abide a greater houre circle, the lesser Globe a lesser, yet I would wishe you rather to exceede in the quantitie, than faile therein, because we take this for a generall rule in any Mathematicall instrument, that the greater it is the more precisenesse and pleasure is in the vse thereof.

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P. Of what fashion would you haue it?

M. Of this fashion which here you see in the figure C. But of what fashion soeuer it is made, it must be so contriued that it may be taken of and on, from the Globe at your discretion.

P. Where must this houre circle stande?

M. It must stande vppon the Meridian, so that the axeltree of the Globe come iust through the centre of it, and the circumference of it be equally distant from the Pole. Also you must obserue this: some Globes are so fastened to their Meridian, that the axeltree cometh iust through the middest of the thickenesse of the Meridian: Other Globes haue their axeltree fastened to the right, other to the left side of the Meridian: therefore when soeuer you set the houre circle on the Meridian, you must so place it that the line of, 12. a clocke both aboue, and beneath, be answerable directly to that part of the Meridian, vnto which the axeltree of the Globe is fastened.

P. Doe you like this fashion of the Index?

M. Yea: yet if it were but halfe the length of the Diameter it were sufficient: but howsoeuer you make it, you must take heede that the points of it be iust in a right line, with the centre of the houre circle.

P. What is the vse of the houre circle with his Index?

M. The particular vse thereof shall appeare better hereafter in seuerall examples. The generall vse is when soeuer there is any question made of time, or the parts thereof, as of a day, or houre, when the Sunne riseth, and setteth, &c.

P. What say you concerning the quadrāt of altitudes

M. The

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M. The uſe of this quadrant and where it muſt ſtande, ſhall be declared hereafter in the particular propoſitions.

P. What would you haue noted in the circle of poſition?

M. The breadth of it is at your pleaſure, the compaſſe of it is the halfe of the Horizon: But in my conceit it were much better if it were of ſuch a Diameter, that the inner ſide ſtanding vpright vpon the Horizon it may fall even with the outside of the Meridian, for ſo it might be made faſt to the Horizon, & the concluſions whereunto it ſerueth might be wrought the better, if there were added vnto it a ſmall ſquire of braſſe which might mooue vp and downe vpon it alwaies at right angles.

P. What is to be ſaid touching the Spherical Gnomon, of what length would you haue it made?

M. As it is vſually made the length thereof is neuer limited. What length ſoeuer it haue you muſt take heed of this one thing, that it be ſo framed, that it may be alwaies at right angles from the Globe.

P. How ſhall I finde that?

M. Finde ſome place in your Globe where two great circles meete togeather, as for example the pointe where the Equator, and the Eclipticke cut one another: ſet one foote of your Compaſſes in their interſection and extend the other at your pleaſure, making therewith ſix or 4. priuie markes in the circles that cut one another on each ſide of there interſection one. Then ſet your Sphericall Gnomon on this foreſaide interſection, and keepe it faſt, that it ſtirreth not, afterwardes ſet the one foote of your compaſſes in one of theſe priuie markes, & extend the other foote to the top of your Gnomon, if the

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foote of your compasses thus extended, will reach from the toppe of the Gnomon vnto all the other markes, in a certaine argument that it is perpendicular to your Globe.

P. The last instrument which you speake of is a needle touched with the Load stone. How would you haue it made, and where should it stande?

M. Each man may follow his fancie, yet for my selfe I would haue the boxe made so square as might be, breadth answereable to the Horizon of the Globe, the bottome of the boxe I would haue the .32. pointes of the compasse, with certaine subdiuisions as occasion should serue eyther more or lesser: also I would haue a line drawne according to the variation of the Compasse, I would not haue it fastened to any certaine place of the Globe, but applied onely to the Southside of the Globe so close as may be, vnto the East or Westside of the Meridian as occasion requireth. Thus much for the instruments belonging to the Globe. Now you may take what course you please for the circles and their vse, eyther simple alone, or ioyntly together, or as they craue the help of these instruments.

P. I must needs confesse mine ignorance in these matters to be great, and therefore I am willing to take the more payne, I pray you giue me leaue to aske, what I thinke good, and I will take the Globe vnto me, and beginne with the Equator following from one to one, vntill I haue runne them ouer all. You say that the Equator is a great circle lying iust in the midst betweene the two Poles: therefore first I conclude this, that the Poles of the world are the Poles of the Equator: as for the degrees of the Equator, I see that they are .360. and that the

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number goeth on continually from one to .360. beginning at that point of the Globe where the Eclipticke crossing both bende towards the North pole.

M. You say true : These degrees for distinction sake in the degrees of other circles the Grecians doe call *horæ*, the Latines *Tempora*, that is times : because by them the severall times of the day, and night are limited, whensoever there is any question made of any time of a day, or the partes thereof, it may well be resolved by the degrees of the Equator, yet the houre circle wherewe spake before doth serve for that purpose.

P. What is the reason of this name ?

M. It is so called because when the Sunne is vnder this circle the day, and night are of an equall length.

P. By your leave Sir, why doe you say (vnder this circle) in common phrase of speech wee say, that the Sunne is in the Equinoctiall, and in the Eclipticke, and in the Meridian, &c.

M. It is true that wee say so, but in these kinde of speeches wee vse the worde (in) for vnderneath, or right against. I tolde you before, that these circles, which are described in the Globe, are especially to be conceaued in the .10. Sphere, and considering that the Sunne is in the .7. Sphere beneath, therefore wee cannot trulie say that he is in the Equator, &c. But when wee say so, our meaning is this, that he is vnderneath, or right against some one of these circles, so that a right line drawne from the centre of the worlde, through the centre of the Sunne, and continued vp to the .10. Sphere, would light vpon that circle in the which the sunne is said to be. Wherefore to returne to my former speech, whensoever the Sunne is (that is to say vnderneath) this circle, the day, and the

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night through out the worlde are equall, wherefoe
the Sunneriseth, & setteth within the space of .24. houre
and therefore it is called the Equator. The Grecians
call it *ισσημερινός*, which worde for worde may be ter
med the Equidiall, but the Latines following the ple
santnesse of the worde, haue chosen rather the Equin
ctiall, deriuing the name from the night, & not from
day, as the Grecians doe. This circle is also tearmed
girdle of the world, in regarde that it possesseth the mi
dle place betweene the poles, as a girdle on the body
a man. The seafaring men for the excellent vse there
doe call it the Line.

P. In that this circle lieth in the middest betweene
the two Poles, what haue I to note thereby.

M. Hereby the Globe is diuided into .2. halves
which we call Hemispheres, wherof the one is the North
Hemisphere frō the Equator to the Northpole, the other
is the South. Item the Equator lying as it doth, is the be
ginning of all declination, whensoever therefore you sh
heare hereafter of the declination of the Starres, of the
declination of the Sūne, or of the signes, it must be counted
from this circle, and whatsoever is precisely in, or vnder
this circle hath no declination. Last of all, in that the
equator lieth iust in the middest betweene the two Poles
of the worlde, wee are to note this, that it must need
mooue vniformally according to the motion of the hea
uen, at no time faster than at an other, but looke how ma
ny degrees thereof arise, & set in one houre, so many de
grees arise, and set in euery other houre: as you your
selfe may prooue hereafter, and therefore as I said it is the
measure, and rule of all time. Thus much concerning the
Equator simply considered in it selfe.

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P. In the Eclipticke (for that is the next) me thinke there doe many doubtles arise. You defined it to be a greate moouable circle of the Globe, cutting the Equinoctiall at oblique angles, and declining from it 23. d. 30. m. toward each pole of the worlde. Therefore by your generall rules set downe before concerning the Poles of the great circles, I maie conclude, that the poles of the Eclipticke are. 23. d. 30. m. from the poles of the world. But what is the chieft end of the Eclipticke?

M. The chieft vse of this circle is to lay foorth vnto vs the proper motion of the Sunne, for euen as you see the Eclipticke line to trauerse the heauen obliquely, and to decline bothe to the North, & to the South poles, euen so dothe the Sunne keepe his course neuer swaruing from this line, but going on euery day from the West to the Eastwarde, almost one degree of this circle, that is to say, 59. m. 8. sec. 19. thirds, 37. fourths. He finisheth his course within the space of 365. daies, 5. houres 48. min. 26. sec. 10. thirds, 56. fourths, which is the length of a yeare. Also this circle is the beginning of all Latitude, so that whatsoeuer is distant from this circle, either toward the one pole, or toward the other, is said to haue a Latitude, as you shall see hereafter, and whatsoeuer is in or vnder it hath no Latitude.

P. Then belike the Sunne neuer hath any Latitude, for, as you said euen now, the Sunne neuer swarueeth from the Ecliptike line.

M. You say true: this circle also serueth for the Longitude of all Starres, or what soeuer else is called in question in the heauen, the which Longitude how it is to be founde I will declare vnto you hereafter: It serueth

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ueth also for the Eclipses of the Sunne, or Moone, as you may gather by the name, for there is no Eclipse, but when the Sunne or Moone are bothe precisely in, or very near vnto this circle. To conclude, whensoever there is any question mooued of the rising, or setting, or any other thing else concerning the Sunne, wee must haue recourse to this circle, because it representeth as I saide euen now the progresse of the Sunne, and there is no day, but the Sunne possesseth one degree, or an other of this circle, the which degree must alwaies be sought out whensoever there is any conclusion to be wrought concerning the Sunne, or the place of the Sunne.

P. Are the degrees of the circle as many as the degrees of the Equator?

M. I told you before that euery circle of the Globe is either expressly diuided into 360. degrees, or else it is to be vnderstood to be so diuided. But herein is a difference: the degrees of the Equator go on continually from 1. to 360. but the degrees of the Eclipticke doe not, for they continue but vnto 30. and then beginne againe.

P. What is the reason of that proceeding?

M. That the yeare and the Eclipticke might be answerable one to an other, as the yeare is diuided into 12. moneths, and euery moneth vsually hath 30. daies, so the Eclipticke is diuided into 12. partes, whereof euerie one is called a signe, and euery signe containeth 30. degrees.

P. What is a signe?

M. A signe is taken properly or vnproperly: Properly a signe is the twelfth parte of the Eclipticke. So that if wee drawe a line from the center of the worlde to the Eclipticke, what soeuer Planet, or Starre falleth precisely vpon that line, is saide to be in such or such a signe.

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at line tendeth vnto.

P. What is a signe vnproperly taken ?

M. If you marke my wordes, I will easily deliuer the whole matter vnto you, but you must plucke vp your vnderstanding, for that whereof I speake is not to be seene but to be conceaued in the Globe. First therefore imagine, that in the surface of the Globe there were two circles drawen parallell to the Eclipticke, the one on the one side therof. 6. degrees distant from it, the other on the other side according to the same distance, so that from the one circle to the other there were. 12. degrees. These circles thus drawne must inclose within them a surface.

P. I vnderstande you : in the ringed Sphere I remember it is called the Zodiacke, and it is parted into. 12. equall peeces, whereof euery parte is called a signe containing in breadth, 12. degrees, and in length thirtie, and resembleth that figure which the Geometricians call a Parallelogramme.

M. That is one signification of a figure. Then imagine that from the. 4. corners of this Parallelogramme there were drawne downe to the centre of the Globe (which representeth the centre of the worlde) a right line, so that they met altogether in one point, these lines with the Parallelogramme aforesaid must needs inclose a solide figure like a Pyramis : this is the second signification of a signe, and whatsoever is within the compasse of this pyramidicall figure, is saide to be in such or such a signe according as the denomination of the base doth importe. Thirdly, imagine that from the Poles of the Eclipticke there were drawen. 6. great circles diuiding the Eclipticke into. 12. equall partes, betweene each two halfe circles next adioyning there must needs be inclosed a
surface

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surface like vnto that of the Globe, which is containned betweenne the Equator, and the Eclipticke, the which are in number. 12. and each of them is called a signe: whatsoeuer therefore is containned from the one pole of the Eclipticke to the other within any of these surfaces, is sayde to bee in such or such a signe as the denomination of each parte of the Eclipticke doth inferre, containned in any one surface. Last of all, if from each side of this surface you imagine, 2. halfe circles to bee put into the Globe, so that they may concurre together in the axeltree, those halfe circles together with this crooked surface, will comprehend a Solide bodie, not vnlike vnto the twelfth parte of an apple beyng diuided equalie: of these bodies there wilbe twelue, whereof euerie one is called a signe: and hereby it commeth to passe that whatsoeuer is within the worlde may bee referred to some signe. Thus much for the signification of the worde,

P. Yet me thinketh you haue omitted one signification: for I haue hearde these Constellations which are set forth vpon the Globe called by the name of the twelue signes.

M. You say true and commonly in sunne Dials, you shall see the 12. signes painted according to these constellations, but they are most vnproperly termed so: and in the vse of the Globe you must especiallie take heede that when there is mention made of any signe, you haue not recourse to these constellations but to the equal partition of the Eclipticke which are properly called the signes.

P. What other thing is to be noted in the signes?

M. Their expression, and their diuision. The signes

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are expressed two manner of wayes, eyther by Characters, or else by names, bothe of them are diligently to be obserued for their vse is manifolde. Their names and Characters are these: 1. *Aries*, the Ramme. ♈. 2. *Taurus*, the Bull. ♉. 3. *Gemini*, the Twinnes. ♊. 4. *Cancer*, the Crabbe. ♋. 5. *Leo*, the Lion. ♌. 6. *Virgo*, the Virgin. ♍. 7. *Libra*, the Ballance. ♎. 8. *Scorpio*, the Scorpion. ♏. 9. *Sagittarius*, the Archer. ♐. 10. *Capricornus*, the Goate. ♑. 11. *Aquarius*, the Watermā. ♒. 12. *Pisces*, the Fishes. ♓. Euery signe as you see excepting one, receaueth his name from some liuing creature, and therefore that broade circle in the ringed sphere, which you mentioned before (the which also is to be vnderstood in the Globe) is called the Zodiacke by the Grecians, who in their language call a liuing creature Zoon and Zodion. Yet some will haue it so called of Zoe life, because the Sunne passing to and fro in it, procureth life vnto liuing creatures.

P. What is the reason why they chose these names and none other?

M. Names are best taken from familiar thinges, wherewith wee are best acquainted: For somuch therefore as the effectes of the Sunne in the course of the yeare are greatlie correspondent to certayne properties founde in these common things, therefore the Astronomers thought it good to intitle the signes by their names. As for example: wee know the Ramme to be of nature hotte and drie, carrying his chiefe credite in his forehead, such is the effect of the Sunne in this signe. Therein he beginneth to make shewe of his heat, & with his heat he inferreth a drineffe, as may be seene by the Marche winds, which then begin to blow whē the Sunne entreth
into

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into this signe. The second signe is the Bull, whose force is more than the Rammes, and his complection is Melancholicke, euen so is the heate of the Sunne augmented, and that melācholike humor beginneth to abound. The thirde signe is Gemini the twinnes, which expresseth the doubled force of the Sunne, and the naturall inclination of each liuing thing vnto copulatiō at that time of the yeare. The fourth signe which is the Crabbe, expresseth the returne of the Sunne, and his going backward as it were: for the Sunne after he is come to the head of this signe declineth no more from the Equator, but returneth againe nearer and nearer to that circle, and here vpon the head of this signe is called the Tropicall point, and that tropicke which toucheth the Eclipticke in that point, is called the tropicke of Cancer. Moreover forsomuch as the Lion of all other creatures is the strongest, and the hottest, and neuer freed of an ague, therefore the fift signe is called the Lion, to signifie the mighty strength that is in the heat of the Sūne, & the subiectiō of our bodies vnto feuers at that time of the yeare. The sixte signe is the Virgin, which signifieth that the Sunne in that signe bringeth forth no new thing, but hasteneth euery thing forward to a ripenesse: euen as the Virgin of her selfe is barren, but groweth euery day riper and riper, as the course of nature doth require. The Balance which is the seuenth signe doth import the equalitie, and equall passing of the day and night, which are then of one length, when the Sunne entreth into this signe, so that the head of this signe & Aries are the Equinoctiall points. The eight signe, which is the Scorpion, signifieth that euen as, if you take not heede of the faire countenance of that beast, you may be priuile, and a

vnawares

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manawares smitten with his stinge, so also if you take not heed to your selfe, at that time when the Sunne possesseth this signe, his faire shew in the morning may so decrease you, that you may be ouertaken with a colde not thought on before night: Likewise the pearcing colde of the frost and snowe falling in the moneth of Nouember is resembled by the arrowe of the Archer which is the ninth signe. The tenth signe is the Goate: the Sunne coming vnto this signe declineth no farther from the Equator, but beginneth then to clime, and mount alofte in respect of vs, that dwell to the Northwarde of that circle, whereupon that tropicall circle which toucheth the Eclipticke line in the head of Capricorne, is called the tropicke of Capricorne: This mounting and climbing of the Sunne, the Astronomers haue thought good to expresse by the figure of this beast, which of all other of that kinde climeth most high, and is by nature Melancholicke and sweareable to the season of the yeare. The Waterman is the .ii. signe, who putteth vs in minde of that abundance of humors which raigne at that time. Last of all the Fishes being the .xii. signe, do admonish vs that when the Sunne is in this signe, the rayne is vsually so plentifull that euery thing may swimme therein, as the fishes in the Sea. There are other reasons of these names taken from the course of the vitall blood, and other humors felte in mans bodie when the Moone possesseth the foresaide signes, the which for breuitie sake I omit.

P. But are these reasons generall and may they go for currant, as well on the other side as on this side the Equinoctiall?

M. Not so: but for somuch as Astronomie was bredde on the Northside of the world, the Astronomers there-

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therefore haue applied their reasons especially vnto the parte . So that when wee are in that parte of the worlde which is beyonde the Equator , wee must vnderstand the contrarie to that, which wee saie, whilest wee are on this side , as for example, wee saie the springe beginneth when the Sunne entreth *Aries*, and the Summer when he entreth into *Cancer* , but to them it falleth out contrariwise, and the beginning of the Spring must be ascribed vnto *Libra*, and the Summer vnto *Capricorne*: &c. as hereafter you shall heare more at large.

P. Why is the first place among the signes ascribed to *Aries*?

M. The Astronomers alleadge certaine reasons for it, which must be receaued fauourable, because they are not necessarie , though sufficient to perswade a well willing minde : the reasons are these :

1. The Sunne comming vnto this signe, each thing beginneth to florish, and that season is most fittest for the generation of all thinges, therefore it carrieth the preeminence.

2. The North parte of the worlde hath a dignitie aboue the South, in respect of the creation and the birth of our Sauour, & whatsoever excellent thing hath been since the worlde was made.

3. The Astronomers inhabiting the North parte of the worlde, haue giuen the first place vnto this signe, because it is the first of all those , which leane from the Equinoctiall Northwarde.

4. Last of all , there be that affirme that the Sunne when he was created, possessed this signe, and in that respect it ought to haue a dignitie aboue the other.

P. I praye you, now tell me are the signes all of one kinde

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ade, or are they ſeuerally diuided and diſtinguiſhed one from another?

M. They are not all of one kinde, but are diuided by their place and their qualitie. By their place they are diſtinguiſhed foure ſeuerall wayes, which are not to be neglected becauſe they haue much uſe in Aſtronomie. Firſt, in reſpect of their place ſome ſignes are ſaide to be Northerne, other are called Southerne. The Northerne ſignes are thoſe which decline toward the North pole: as γ . δ . Π . $\ominus$. Ω . μ . The Southerne ſignes are thoſe which decline to the Southwarde: as ν . ζ . $\wp$. $\sim$. χ . Secondly, the ſigne in reſpect of their place are ſaide to be oppoſite: as γ . to $\sim$. δ . to χ . Π . to ζ . $\ominus$. to $\wp$. Ω . to $\sim$. μ . to χ . Thirdly, ſome ſignes are named Cardinall, ſome Equinoctiall, ſome Tropicall, & Solſtitiall. The Cardinal ſignes are γ . $\ominus$. $\sim$. $\wp$. ſo called becauſe they are the mayntes, and as it were the thinges whereupon the foure quarters of the yeare are turned rounde, and haue eſſe and regreſſe. For the Sunne coming to the head of γ the ſpring beginneth, and the ſignes from thence to the head of *Cancer*, are called the Vernall ſignes, or the ſignes of the ſpring time, namely γ . δ . Π . When the Sunne commeth to the head of $\ominus$. the Summer commeth in, and the three ſignes from thence, that is $\ominus$. Ω . μ . appertaine to that ſeaſon. The Harueſt diſplayeth it ſelfe when the Sunne entreth into $\sim$. and theſe three ſignes $\sim$. μ . ζ . are called Autumnall ſignes, and are appropriate to that ſeaſon. The winter beginneth when the Sunne toucheth the head of *Capricorne*, and theſe ſignes $\wp$. $\sim$. χ . are attributed to that quarter of the yeare. The Equinoctiall ſignes are γ . & $\sim$. becauſe the

Sunne

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Sunne in those two points onely, and no more touche the Equinoctiall line (as you may perceave by the Globe) and then onely are the dayes and nights equall. The tropicall and solstitiall signes are all one, namely $\odot$ and $\cap$, yet diuersly denominated because of sundry effects which fall out in them. For so much as the head of $\odot$ and $\cap$ are the limites and boundes of the Sunne eyther comming to the Northward towarde vs, or declining from vs to the Southwards, so that he passeth not beyond them, but returneth presently towarde the Equator, therefore these signes are called the tropicall signes (as I partly noted before) and the head of eyther signe is called tropicall point. These signes and points are called Solstitiall, because as the water, when it is a full sea neare a full sea, doth flow or ebbe so flowlie, that we thinke it to stande still, and therefore call it a still water even so the Sunne coming to these points is said to stande (though his motion be continuall without ceassing) that his declination from, or towarde the Equinoctiall can hardly be discerned for the smalnesse thereof. These signes also are diuersly distinguished according to the qualitie, but it is not for me in this place to reckon them because they belong to Iudiciall Astronomie, which calleth some of them Masculine, some Feminine, some Diurnall, some Nocturnall, some Moouable, some Fixed, some Common, &c. The qualities whereby the signes are vsually distinguished are either Elementall or Humoral. So that the signes are diuided according to the 4 elements, and humors rainging in our bodies. The elementall qualities are such as are in the elements, as heate, colde, moisture, and drinesse. The fire is hote and drie are some signes, & are therefore called fire, as γ . δ .

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which because they are but .3. in number, are called the fire triplicitie. The ayre is moyst and hot, so II. ♈. ♎. which make the ayrie triplicitie. The water is colde and moist, so are ♊. ♋. ♌. making the watr triplicitie. The earth is drie & colde, so are ♍. ♏. ♐. which make the earthly triplicitie. The humorall qualities are such, as are in the .4. humors of our bodies, and are wereable to the qualities of the .4. Elements. The first humor is choler, which is hot & drie like the fire, whereon the fire signes are called also cholerick. Bloud agreeth in qualitie to the aire, which is hot and moist, therefore the airie signes are also Sanguine. The water & me agree in qualitie, being both cold & moist, so that watrerie signes are called flegmaticke. Melancholie and earth are drie, & cold, the earthly signes therefore are called Melancholicke. And to the intent that you may most easily carrie these qualities of the signes in memorie this: Choose .4. fingers of your hand, and call the first, the second earth, the thirde aire, the fourth water: beginning at γ. count the .12. signes vp to your foure fingers, so shall you finde which are fire and cholericke, which is hot and drie, which earthly and melancholicke, which is drie and colde: &c.

P. There arise in this place. 2. doubtes wherein I should gladly be resolued: First the Philosophers haue set downe this as a principle, that in heauen there is neither heate nor colde, in what respect then are the signes to be of these qualities. Secondly the naturall placing of the Elements is this, the fire is first and the ayre second, & then the water, the earth it self is last of all, what is therefore the reason of this disorderly placing of the signes, why are the earthly signes in the second place?

E

M. The

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M. The ancient Astronomers, men of great experience, and paines, observing the sundry changes and alterations of all things here vpon earth, noted that the Sun and other planets coming to certaine places of the heauen, did moue some of these inferior bodies more than other some, and stirred vp their qualities more or lesse or otherwise diminished the. The qualities, whose augmentation, diminution, & alteration they especially obserued, were these beforenamed, because they were more subiect to comon sense. And considering that as black and white, so heate and cold, drynes and moisture cannot be in one, and the same subiect being contraries: therefore they affirmed certain places to be hot, others to be cold, some to be moist, and some to be dry, not actually as the elements are, but virtually by their vertue and power. From this experience I might draw an answer to your second question, that because they obserued in γ , which is the second signe, the earthly qualities, that is drought and coldnes, therefore they placed the signes as they be. Yet I pray you also note this in the elements, there are qualities one intensiue & predomināt, which is the chiefest of the two, the other is remisse: as in the fire the predomināt quality is the heat, the remisse qualitie is the drynes, these elements are changed one into another, not at all aduentures, but successiue from one to another that naturall change is fitly expressed by the placing of the signes. The fire which is intensiue hot cannot become moist immediatly, but it is always dry, yet may it lose his heate and become cold and dry, which are the qualities of the earth. The first signe therefore being fire, the second is earthly, to signifie this naturall alteration. Again the aire is intensiue moist, and remissiue hot, therefore

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ore it cannot be dry, but it may lose his heate, and become cold, as the water is, and therefore those 2. signes succede one an other. I might deriue also a reason of this disorder from the seuerall aspects of the signes, which is not to be neglected in the eclipticke, for in this circle they are to be accounted.

P. What meane you by that word, aspect, which you say, is to be obserued in the signes?

M. An aspect is a position of the signes (it is a thing incident also to the planets) in a determinate distance of the ecliptick line, from whence they may as it were beholde one another.

P. How many aspects are there?

M. Hauing regard vnto the Planets, there are five aspects, for they may be right vnder one an other, or else they may be in one and the same great circle drawne from the poles of the eclipticke through the center of each Planet: this aspect is called coniunction, and is expressed with this character γ . the other aspects are sextile, quadrature, trine, and opposition: these 4. are only in the signes, for the signes are not said to haue coniunction. Sextile is an aspect of the signes (or planets) when they are distant one from an other the sixt part of the eclipticke that is 60. degrees, as γ . and π . δ . and ϕ . &c. it is expressed thus. $\ast$. Quadrature is an aspect of the signes when they are distant one from an other 90. degrees, which is the fourth part of the eclipticke, as γ . and ϕ . or ϕ and π . it is thus expressed $\square$. Trine, which is also called trigonall, or triangular, is an aspect of the signes, when they are distant one from an other the third part of the eclipticke, which is 120. degrees, as γ and Ω the character of this aspect is this Δ , Opposition is

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an aspect of the Signes when they are distant. 180. degrees, which is halfe the Eclipticke, so that the one signe is in the one end of the Diameter, and the other signe in the other end: as γ . and ω . or ϕ . and ψ . this aspect is expressed thus $\odot\odot$.

P. What is the reason that the quintile is exépted?

M. If you marke it, there is no aspect hether to named, but the number, which giueth the denomination thereto, will exactly diuide. 12. for so much therefore as 5. from whence the quintile aspect, if there were any such, is to receaue his denomination cannot diuide. 12. exactly, therefore that aspect is excluded by the Astronomers. Thus much for the quantitie, that is the number of the aspects.

P. If there be any thing to be saide, touching their qualitie, I pray you let me heare it, it cannot be much besides the text.

M. The qualitie of the aspects is eyther certaine or vncertaine. The certaine is eyther good or badde bothe of them are either perfect or meane. The perfect good aspect is the trine because the signes, which beholde one an other in that aspect, agree in bothe their qualities: as γ . and Ω . are both hot and drie: as δ . and π . are both drie and colde, &c. The meane good aspect is the Sextile, because the signes placed in that aspect do in qualitie partly agree, and partly disagree: as γ . and π . agree in heate, but the one is drie the other moiste, yet are they not directly opposite. The badde aspects are the Quadrature and the opposition. The vncertaine aspect is the coniunction for it is sometimes good, sometimes badde, according to the Planets which meete together. Out of the consideration of these aspects ariseth that disorderly placing

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placing of the Signes which was mentioned before. The Astronomers perceauing the contrarietie which fell oute implienowe and then in the quartile aspect, that the Signes, which were so placed, did oppugne one the other sometimes in bothe the qualities, as γ . and $\odot$. whereof the one is fierie, the other watric, they could not dispose of the signes in that order as the elements are placed, for by that meanes the first signe should neuer haue oppugned the fourth in both qualities, but they should alwaies haue agreed in the one, which thing was contrarie to their obseruation. Thus haue I briefely run thourough those things which are simple to be respected in the eclipticke. Let vs now proceede to the *Colures*.

P. What is the reason of that name?

M. *Colurus* properlie signifieth *Cauda Mancus*, taimed in the taile, for these circles (excepting one position and situation of the sphere whereof I will speake hereafter) do alwayes appeare vnperfect. Their office is this, to distinguish the .12. Signes, according as they are answerable to the foure seasons of the yeare, for you see them to diuide the Zodiacke into foure partes, whereof the one containeth the Vernall signes, the other the sommer signes, &c. Moreover, the Solstitiall colure passing through the head of $\odot$. affordeth vs alwaies the two poles of the eclipticke in this manner. If you turne the head of $\odot$ toward you, this is a certaine rule, that looke how farre the head of *Cancer* is about the equator, so farre is the north pole of the eclipticke beyond the north pole of the world, and the south pole of the eclipticke is so farre on this side the South pole of the world. If you turne the head of *Capricorne* toward you, it falleth

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out contrarywise.

P. I perceave it well, for then the north pole of the eclipticke is on this side the north pole of the world, and the south pole of the eclipticke is beyond the south pole of the world so farre as the head of *Capricorne* is distant from the equator. Where are the poles of the *Colures*?

M. There is no great vse of them in the Globe, yet if you desire to knowe where they be, the former generall rules will leade you to them: you shall finde the poles of the equinoctiall colure to be in the intersections of the equinoctiall, and the solstitiall colure: and the poles of the solstitiall colure to be in the intersections of the equinoctiall colure, and the equator itselfe. The graduation of the colures in the celestiall Globes vsuallie is omitted, but in *M. Mollineux* his Globe, the equinoctiall colure is graduated from the equator toward each pole of the world the solstitiall colure is graduated from the eclipticke toward each pole thereof, to the intent that the Globe may be readie both for the declination and latitude of the Starres. Let vs now come to the Horizon. Wherein you must first vnderstand, that the breadth which is geuen to the Horizon, or any other circle else generally belonging to the Globe, is not giuen vnto it as an Horizon (for simple as it is an Horizon, or a circle of the sphere, it is a line without any breadth) but the breadth is allowed it for the degrees and other things necessarie for the vse of the Globe.

P. I vnderstand you well, but I pray you expresse vnto me particularlie what things these are that are inscribed in the Horizon, and what vse they haue?

M. There

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M. There are inscribed in the Horizon the 12. signes, the 12. moneths of the yeare, and the 32. windes (which are commonlie called the points of the Compass) both in english and latine.

P. Nay by your leaue Sir. I am not yet fully satisfied, I minde to goe more particularlie to the matter. What degrees are those which are set in the inner side of the Horizon?

M. They are the degrees of the 12. signes, and the numbers that stand next vnto them are the numbers of the degrees of each seuerall signe from 10. to 10. In the third space next vnto the Horizon are set the names of the twelue signes with their characters, the name standeth at the beginning, the character at the ende of each signe.

P. But what meaneth the character which is in the midst of euery signe?

M. It signifieth that the signe is the house of that planet, vnto whome the character doth belong, as for example, *Aries* is the house of *Mars*, *Taurus* is the house of *Venus*, &c.

P. What is the reason why the first signe is set in the east point of the Horizon, and from thence successively they goe about by the North?

M. That is done to helpe the memorie of the notice in Astronomie, all the signes from the east, counting about by the North to the West, are those which before I counted the Northern signes, the other are the Southern signes. The partitions which follow the names of the 12. signes, are the dayes of each seuerall moneth: next vnto them succede the number of the dayes belonging to each moneth.

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P. But what meane the letters set vpon each seuerall daie.

M. They are seuen letters of the alphabet answerable to the seuen dayes of the weeke: the letters are iterated according as the dayes of the yeere doe require. Of these letters, that which is appropriate to the Sunday, is called the Dominicall letter for that yeere.

P. Whie? is not euerie yeere the same letter appropriate vnto the Sunday? these letters keepe alwayes the same dayes of the moneth, for A serueth continually the first of Ianuarie, B the second, C the third, &c.

M. It is true that the letters are answerable to those dayes, yet doth the Dominicall letter change euery yeere, and in the leape yeere there is two Dominicall letters. The reason why they change is this, there is in the yeere one day more than 52. weekes, as you may perceiue by the letters, for the last of December, and the first of Ianuarie are marked with one letter. If there were iust 52. weekes, the Dominicall letter could neuer change, for then if the first day in the yeere were Sunday, the last day would be Saturday, and the first day of the next yeere continually would be Sunday againe, and A would still be the Dominicall letter. But in respect of the odde day it falleth so out in euery common yeere, that the yeere beginneth and endeth with the same day, as if the first of Ianuary be Sunday, the last of December that yeere is Sunday also, the first of the next yeere being Monday, the Dominicall letter must needs change, and being A, it becommeth G, thus much shall suffice for that matter.

P. In that space where the number of the dayes are expressed, I note certaine letters to be written, namely,

lic,

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K. N, and I. to what vse seruet they?

M. They signifie the manner which the ancient Romanes obserued, in expressing the dayes of euerie moneth. They did not count their dayes from one to another, as wee doe, but they diuided their moneth into three seuerall partes, which were Kalends, Nones, and Ides, according as the three foresayd letters doe import. The first day of euerie moneth was called the Kalends, and therefore the letter K. is applied vnto it throughout the horizon. The other dayes of the Kalends, were they more, or lesse, did not succcede in the same moneth, but did goe before in the former moneth, and were counted backward. As for example, the Kalends of Ianuarie did not follow the first of Ianuarie, but went before in the moneth of December in this manner: the last of December which is the 31. day, they called the day before the Kalends: the 30. of December was the third of the Kalends of Ianuarie, the 29. of December was the fourth of the Kalends of Ianuarie, and so they counted them to the 14. of the moneth of December, which was the 19. of the Kalends of Ianuarie. Which moneth had more Kalends, and which had lesse, may be gathered easily out of the horizon by the place of the letters. Also you may finde which moneth had more Nones, and which had lesse. The number of the Ides in euerie moneth was equal, namely 8.

P. But were the Nones and the Ides counted backward as the Kalends were?

M. Yea, for where you see the letter N stand, that was the first of the Nones. As for example, the 5. of Ianuarie was the first of the Nones of Ianuarie, the last of the Nones was the 2. of Ianuarie, so that the Romanes
account

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account was contrarie to ours. Likewise, the 13 of Ianuarie was the first of the Ides, the last of the Ides was the sixt of Ianuarie. These things are to be regarded speciallie by the learned sort, that they may be skilfull in the account of the ancient Romanes.

P. The next space which followeth containeth the names of the moneths. I pray you let me haue a word or two with you concerning them, because not being skilfull in the Latine Authors, I cannot satisfie my selfe in many things, which I would gladlie knowe. Tell me I pray you hath this number of moneths bene continuall, I speake of the Romanes.

M. No, for *Romulus* the first King of Rome counted but 10. moneths to the yeare, according to the time which a woman beareth her child in her wombe. *Numa Pompilius* succeeding him, added other two moneths, namely Ianuarie, and Februarie, so that hence by he made the moneths of the yeare answerable to the 12. signes. This number of the moneths hath continued still.

P. Hath the order of them bene all one from the beginning.

M. *Romulus*, who was the first author of the yeare, began it at the moneth of March, in the honour of *Mars* his father. *Numa Pompilius* adding two other moneths, made Ianuarie the first, and Februarie the last moneth of the yeare, because it was consecrated to the infernall gods. The *Decemviri* afterwards ioyned Ianuarie and Februarie together, and made Februarie the second moneth of the yeare.

P. What is the reason of their vnequall quantitie?

M. It was not possible that they should all be

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quantitie, because of the motion of the Sun making
seuerall dayes of the yeare, if the Sunne had gone
his euerie daie one degree of the Eclipticke, then
the euerie moneth of the yeare haue had iust 30.
dayes, but considering that there is five dayes more in
the yeare than there are degrees in the Eclipticke, it is
impossible, but that five moneths must haue one odde
daye more.

P. But now there are 7. moneths which haue 31.
dayes, and one moneth hath but 28.

M. It is so: first there were but five moneths
which had 31. dayes, but *Iulius Caesar* tooke one daye
from Februarie to put to Iulie, that as he thought him-
self inferior to no man, so his moneth should haue as
many dayes as anie other. *Augustus Caesar* succee-
ding him, and being as ambitious as his predecessor,
drew an other daie from Februarie, and ioyned it
to his moneth August, to the ende that it might not be
inferior to Iulie in the number of dayes.

P. Haue these names of the moneths continued
from the first beginning?

M. No. For the moneth of Iulie, because it was
the fift from March, was called in olde time *Quintilis*,
August being the sixt, was called *Sextilis*. More-
ouer, *Domitianus Germanicus* Emperour of Rome,
changed the name of September, and called it *Ger-
manicus*, because in that moneth he ouerthrew the
Germanes. Hee changed also the name of October,
and called it *Domitianus* after his owne name, but
after his decease, those two moneths receaued their
ancient names againe.

P. What

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P. What is the reason of these names?

M. The moneth of Ianuarie hath his name of latine word *Ianna*, which signifieth a gate, a dore, or entrie, because it is the first entrance into the yeare. else it receaueth his name from *Ianus* the two faced God, to whome this moneth was consecrated. Februarie receaued his name from the word *Februnus*, who was the infernall God, otherwise called *Pluto*, to whom in this moneth the Romanes did sacrifice: or else of *Februa*, which were sacrifices, and ceremonies for purging of soules, which in this moneth especially they offered to the Gods beneath. Some deriue it from the word *Febris*, an ague, because in this moneth they were sore with what rife. Marche receaueth his name from *Mars* the father of *Romulus*, and God of warre, as the Romanes accounted him, and in this moneth they began their warlike prouision. Aprill, this moneth was consecrated to *Venus* the mother of *Aeneas*, from whome the Romanes set their discent. The Grecians called her *aphrodite*, to signifie, that she was bred of the foame of the sea, which is by them called *aphros*, and from thence they set the name of this moneth, striking out the *ph* calling it Aprill as it were Aphrill. But *Varro* thinketh it more conuenient to deriue the name from the Latine word *aperio*, which signifieth to open, because the earth beginneth then to be free from the binding force of frost, and to send forth the grasse and other fruites. The moneth of May hath his name deriued sundry wayes. Some will haue it taken from the word *Maius*, that is *Iupiter*. Others deriue it from the Goddesse *Maies* daughter (as the poets will haue) of Honour, and Reuerence, because in this moneth the first worship of the

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ls began. Others take the name from *Maia*, the
of *Vulcane*, vnto whome, *Vulcans* high Priest
sacrifice in the Kalends of May, which is the first of
moneth. Others say, this moneth was so called of
the daughter of *Atlas*, and mother of *Mercury*
of Merchants, because in this moneth the Mer-
ts offred sacrifice to *Mercurie*, and *Maia*. Last of
me affirme, that in this moneth *Romulus* diuided
people of Rome in *maiores*, & *minores*, that is,
the elder, and yonger sort. *Hinc sua maiores tri-*
be vocabula Maio. So that this moneth receaued
name from the *maiores*, that is, the elder sorte,
hath his name also deriued from sundrie things,
e fetch the name from *Iunius Brutus*, by whome,
quinus, and the name of the Kings were expelled
ome. Others deriue the name from *Iuno Moneta*,
whome for her good admonition, and counsaile in
ng the fearefull earthquake at Rome, the Romanes
rated a Chappell the first of this moneth: so that the
eth was called *Iunonius*, and afterwards *Iunius*, to
de the length of the word. Others call it *Iune* &
endo of ioyning, because in this moneth the Ro-
es and *Sabines* were ioyned together in one citie:
ers take it from *Iuuenta* the Goddesse of youth,
wife of *Hercules*. *Ouid* writeth thus, *Iunius a*
num nomine dictus adest, that as May was deri-
from the *maiores*, that is, the elder sort, so Iune
ld be deriued from the *minores*, that is, the yonger
Iulie is deriued from *Iulius Caesar*, who was borne
is moneth: it was first called *Quintilis* as I sayde
re. August taketh his denomination from *Angu-*
because in that moneth he greadie augmented the
Empire

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Empire of Rome, and came three times triumphing
the Citie, September is so called, because it is *Septim*
a Vere, the seuenth from the Spring time, at which
as I noted before the auncient Romanes began
moneths. Likewise October is the eight, Nouem
the ninth, December the tenth from the Spring. T
you heare the reason why euerie Moneth is called by
name. The great space which is next to the name
the moneths containe the names of certaine daies
the which those that are written in the greater Rom
letters, are the names of the festiuall daies obserued
the Church of England.

P. What is the generall vse of placing the fig
and the moneths in the Horizon?

M. They serue to this purpose, the daye be
giuen to finde the place of the Sunne in the Ecliptic
that is, what signe of the Eclipticke, and what degree
euery signe he doth possesse, with his entrance into
signe: and contrarywise, the degree which the Su
possesthe being knowen, and the signe to finde the
of the moneth, the which things are very necessar
the vse of the Globe. For many questions cannot
be answered, except the place of the Sunne be know
The day therefore of the moneth being found out in
Horizon, the degree which standeth right against
day is the place of the Sunne. But considering that in
Leape yeare there is a day more than in the other th
yeares that went before it, and that day is put in
wayes immediatly after the 24. of Februarie, ther
in that yeare after the foresayde 24. day of Februar
if you seeke the place of the Sunne, you shall adde
daye more than the number of the daye is in wh

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u seeks the place of the Sunne. As for example, If
u seeke it the eyght and twentieth of Februarie, you
shall take the fyrste of Marche: and if you seeke it
the fyrste of Marche, you shall take the seconde of
Marche, &c. For so shall you come nearest to the
truth.

P. Why then doth not this table affoord the pre-
cise place of the Sunne?

M. No, but it is done to helpe the nouice in
Astronomie, vntill hee attaine vnto farther know-
ledge in that Arte, and this is sufficient for him, be-
cause in common practise hee shall neuer by sense finde
difference betweene this, and the exact place of the
Sunne.

P. What meane the names of the moneths that
are set downe, howe chanceth it that they are twise set
downe?

M. The first of them is the new reformed Al-
manacke of the Romanes proclaimed by *Gregorie Pope*
of Rome. The other is that which our Countreyman
D. hath lately set forth, contayning the true compu-
tation and reduction of the moneths to their first and
ancient seates, the which were therefore set downe in
this Horizon belonging to this Globe, that thereby
might be seene the difference that is betweene our Ka-
endar, and that of the new stile, and also that wee may
easily keepe an account according to our owne, and
our Kalendar.

P. I praye you geue mee some instructions tou-
ching thys matter: for I see some Globes that haue
their Horizon described after the newe Romane Al-
manacke (namely, those Globes which were made

at

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at Amsterdam, by Ieames Floris) the which troubleth me many times, because I cannot reduce them to our account.

M. You see this, that the newe Romane Almanacke preuenteth our 10. dayes, and the other preuenteth our 15. dayes, one rule applied orderlie to the bothe shall be your direction in them: in this manner. If the day of the moneth be assigned according to our account, and you hauing none other Horizon but the which is made after the new stile, would notwithstanding know what degree and signe the Sunne possesse, adde tenne dayes vnto the number of the day propounded, and seeke that out in the horizon the degree of the signe which is correspondent to that day is the place of the Sunne. As for example, the 11. of August I desire to know the place of the Sunne by the Horizon made after the new stile. I adde 10. to the number of the daie it maketh 21. which number I seeke in the Horizon, and right against it I finde the 27. degree and 30. min. of Ω .

P. But put case the question were propounded concerning the 24. of August, if I should put 10. to the number, it maketh 34. how shall I make answer here considering that August hath not so manie daies?

M. If the two numbers added together exceed the number of the daies belonging to the moneth assigned, take the daies of the moneth assigned from the tall summe, the number remayning is the dayes of the moneth following, as in your example 24. and 10. maketh 34. August hath but 31. dayes, take them from 34. the remainder 3. referreth me to the third of September: the degree answering vnto that daie is the place of the Sunne. Contrarywise, if you knowe what degree of the Ecliptic

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ke the Sunne possesseth, and by the Horizon of the
w stile you would know what day of the moneth it is
ording to our account, first seeke in the sayd Horizon
e day opposite to that degree, and if it be possible, sub-
ct 10. from the number, the remainder giueth the day
the moneth according to our account: as for ex-
ple, if against the degree of the Sunne you finde the
day of any moneth, the day vpon which the Sunne
fesseth that degree according to our account, is the 11.
y of the same moneth.

P. But put case I cannot subduct tenne from the
mber of the day which standeth against the degree
igned?

M. Then adde that number to the number of the
yes belonging to the moneth next before it, and sub-
ct 10. from the totall summe, the remainder is the
y of the moneth immediatlie going before, according
our account. As for example, the day answering to
degree of the Sunne in the Horizon of the new stile,
he sixt of August, forsomuch as I cannot subduct 10.
m this number, therefore I adde it vnto the 31. dayes
Iulie, the totall summe is 37. from whence I take 10.
remainder is the 27. of Iulie, vpon which day the
ne possesseth the same degree (namely, the 13.d.5.m.
N) which he possessed the sixt of August according
he new account. This that I haue sayd touching the
w Romane Kalendar, may be sayd of the other next
oyning to it, taking the number 15. for 10. To con-
de, this is a generall rule for you to note, that what
ree soeuer in the Horizon you finde the Sunne to
fesse the same degree, must be sought out in the E-
ticke: the which degree wee call manie times simplic

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the Sunne, sometimes wee call it the place of the Sunne and therefore whensoever wee saie bring the Sunne to the Meridian, or bring the place of the Sunne to the Meridian, &c. our meaning is, that you should bring the degree of the eclipticke which the Sunne possesseth to the Meridian, or to the Horizon.

P. Do these degrees of the signes continuallie answer to the same dayes of the moneth?

M. No, but they may serue the turne 24. yeares, 30. without great inconuenience. That they doe keepe the same dayes of the moneth, you may see the entrance of the Sunne into the equinoctiall point and into the solstitiall points: for the vernall equinoctiall at the Incarnation of Christ, was the 25. March, and the sommer solstice was the 24. of Iune. The Nicene Councell found the vernall equinoctiall to be the 21. of March, and now it is the eleuenth of the sayd moneth. The reason of this difference is, in *Iulius Caesars* Almanack which wee follow, presupposeth the yeare to be 365. dayes and 6. houres, which being greater than the yeare of the Sunne, it commeth hereby to passe, that the Solare yeare preuenteth the yeare of *Iulius Caesar*, and draweth by litle and by litle nearer vnto the first day of the moneth, so that in time to come the entrance of the Sunne into the head of Aries, which is the equinoctiall point, will be the first of March, if there be not a correction vsed. In the other spaces that followe are set the names of the winds which commoie wee call the 32. points of the compass both in english and latine, to the intent that not only the learned, but the ignorant also might haue vse of them. The latine names the author thought good to followe

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Lemnius, both in reſpect of the learning of the
name, and alſo becauſe the names which are vſed by
others ſauour rather of the Italian ſpeech, than of the
ancient Romane tong. The vſe of them is excellent as
ſhall be declared hereafter, both for the place of the riſing
and ſetting of the fixed ſtarres, and the Sunne, and alſo
for their coaſting round about the heauen.

P. This is one thing that I would faine be reſolued
why in ſaying the compaſſe as the mariners tearme
they begin at the North point, and ſo goe on from
thence Eaſtward, were it not as good to begin at the
eaſt where the Sunne alwaies riſeth?

M. In deede if the Sunne did alwaies riſe full Eaſt,
were conuenient the compaſſe ſhould begin there:
but they follow the Sunne, and for ſo much as the vt-
termoſt riſing of the Sunne is at the North point of the
horizon, and beyond that he cannot riſe, as you ſhall ſee
hereafter, therefore they begin there. Thus much con-
cerning thoſe things which are deſcribed vpon the Ho-
rizon of the Globe, whereof the points of the compaſſe
muſt be vnderſtood in the Horizon of heauen, and be-
ſides them certain degrees: for the quarter frō the Eaſt to
the South, frō the Weſt to the South, alſo frō the Eaſt to
the North, and from the Weſt to the North, is to be vn-
derſtood to be deuided into 90. degrees, the nūber of which
degrees is not vſually expreſſed, becauſe the degrees of
the ſignes next vnto the Globe may eaſily ſupply them.
The reaſon why each quarter muſt be vnderſtood to be
thus diuided, is the differēce which is between the lear-
ned & the cōmon mariner. The common mariner ſeing
a ſtar or the Sun to riſe and ſet, vſually nameth the point
of the compaſſe vpon the which it appeareth, as, that

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It riseth East, Northeast, or East, and by South. The learned Astronomer he counteth how many degrees they rise from the East, and how many degrees they set from the West, as that the Sunne riseth 22. degrees 30. min. the Northward, or 11. degrees $\frac{1}{4}$. to the Southward. Therefore that you may quicklie vnderstand them both you must accustome your selfe to turne the degrees each quarter into the points of the Compasse, and contrariwise the points of the compasse into degrees, in this manner. The whole circle is diuided into 360. degrees, therefore the 32. points of the compasse, and 360. degrees are equall, the quarter of the circle containeth 90. degrees, and 8. points of the compasse, euery point of the compasse therefore containeth 11. degrees. two points containe 22. degr. $\frac{1}{2}$. three points containe 33. degrees. $\frac{3}{4}$. foure points containe 45. degrees. Now demaund what you thinke good concerning the Horizon, as it is to be conceaued in the heauen.

P. I haue diuers things to aske concerning this circle, I will set them out of the definition : which is this, The Horizon is a great fixed circle of the Globe diuiding that part of the heauen which is seene, from that part of the heauen which is not seene. First tell me what is the reason of the name ?

M. You obserue this, that when you stande in a plaine champion countrie, where there is nothing to hinder your sight, that round about you there seemeth a circle to be described, which is a representation of the circle whereof wee speake : beyond this circle you see nothing, neither doth your sight passe it, but endeth there, whereupon the Grecians haue called it the Horizon, of the word $\sigma\pi\acute{\iota}\zeta\omega$, which is *finio*, to ende, the

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es also call it *finitor*, that is the ender, because it limiteth our sight.

P. You say it is a fixed circle : what meaneth that ?

M. My meaning is, that it neuer stirreth nor moueth, as it may be proued by a most certaine argument taken from the poles thereof in this manner. The Horizon, as you may perceiue by the Globe, cutteth the meridian at right angles, the poles therefore of the Horizon by that generall rule which I gaue you at the first, must needs be in the Meridian, the one of them is that point of the Meridian, or that point of the heauen which is right ouer our head, and is called the Zenith, the other is the point right vnder our feete, and is called the Nadir : when the poles be the points directlie aboue, and directlie beneath vs where wee stande, and no pole can come nearer to his circle in one place than in an other, it is alwayes equallie distant on euerie side from it, it must needs followe, that so long as wee stand still, the horizon must be fixed, for if it should rise vpward, it must come nearer, if it should moue downeward, it must fall farther from the verticall point which is our Zenith, and the pole of that circle.

P. What then? doth the Horizon moue when wee moue ?

M. Not so : but that Horizon standeth still, and you transport your selfe into an other, so that you are bound to change your Horizon.

P. Are there then so many Horizons ?

M. Herein is the difference betweene the other circles of the Globe before named, and the Horizon, they are but one in the heauen, as one equator, one eclipticke, &c. But the Horizons are infinite, not to be

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numbred, every man hath his Horizon in truth, yea many points as there can be conceaued, in the halfe of the heauen so many Horizons are to be vnderstood though not sensible to be discerned in a small space for the sensible alteration of our Horizon can hardly be perceaued in 400. furlongs, which amount vnto 80 miles.

P. You say that the Horizon diuideth the heauen, but how doth it diuide it into equall, or into vnequall partes.

M. It is a great circle, therefore it diuideth it into equall partes.

P. When I looke round about me standing in a plaine champion feeld, doe I see iust the one halfe of the heauen?

M. Here you must vnderstand, that the Horizon is taken two seuerall wayes, the one is called rationally or naturall, because it is the true horizon represented by the horizon of the globe, and not by sense, but by geometrical reason, to be comprehended to diuide the heauen equallie. The other is sensible and apparent: that is it is that space of the land and sea which our eye sight beholdeth, and from thence runneth on vnto the heauen. And for so much as the centre of the Horizon is not in our sight, the which is farre distant from the centre of the world, through which the diameter of the true Horizon doth passe, therefore reason telleth vs this, that it cannot be so great as the other is, and consequently cannot diuide the heauen into two equall partes: yet considering that the Globe of the earth in respect of the heauen is insensible, so that our sight cannot make a sensible distinction betweene each Horizon, therefore although our reason affirme an vnequalitie, wee ac-

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...nt them equall.

P. Have you any thing else to be added touching the Horizon?

M. As the equinoctiall is the beginning of all declination, and the ecliptick is the beginning of all latitude in the celestiaall globe, so is the Horizon the beginning of eleuation, altitude, or height. Whatsoever is in the Horizon hath no eleuation, whatsoever is aboue it, hath an eleuation more or lesse, as hereafter you shall heare. It is the beginning also of all depression. In it are counted the amplitude of euery thing, that riseth or setteth in the heauen, and the seuerall coasting of the Sun or stars, which is called the Azimuth or verticall circles, &c. But now come to the Meridian. You see that it cutteth the Horizon at right angles, and standeth so vpon it, that it leaneth neither to the one hand nor to the other, therefore the poles of it must needs be in the Horizon, in the East and West points thereof. In it are contained the poles of the world, and the poles of the Horizon, which I called before the Zenith, and the Nadir. The degrees thereof are 360. not continued as the degrees of the equator, but are counted from 1. to 90. for it is most conuenient for the rayfing of the pole, and the equator aboue the Horizon. The vse of it simply considered in it selfe, is the diuiding of the heauen into two equall partes, whereof the one is the East, and the other the West. Whatsoever is toward the rising of the sunne, is the East, whatsoever is toward his setting is the West part of the world, and by it the day is distinguished equally. From it (as you heard before) wee begin to account the points of the compasse, and the variation thereof.

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P. Are the Meridians manie in number, or are there no more than one, as wee see in the Globe?

M. The Meridians are not so many as the Horizons in number, yet are they so many, that wee may tearme them infinite in respect. Which way soeuer you goe the Horizon differeth, because your verticall point differeth, but the Meridian differeth only betweene East and West. If you goe North, or South, your Meridian continuallie is the same, because your Zenith, or verticall point is alwaies in the selfesame line: so that the Meridians in truth are so manie in number as there are points betweene the South and North part of the Globe, as you see it diuided by the Meridian, though by sense they cannot be discerned. Notwithstanding, we commonly count those that are of one Shire, or Citie, or Towne, to be vnder one Meridian, because the sensible distinction of one Meridian is not perceaued scarcely in 300. furlongs, which are 37. miles $\frac{1}{2}$. Thus much touching the great circles of the Globe, as they are simply considered by themselves, now of them iointly considered with an other, and first generallie without respect haue vnto any certaine position of the Sphere. Here these things do offer themselves to be considered, 1. the equall diuision of the great circles by the Horizon, 2. the vniforme motion of the equator, 3. the declination, 4. the longitude, 5. the latitude, 6. the foure cardinall points of the world, 7. the goodnes of the Globe. Howsoeuer the Globe is situated in the Horizon, be the pole higher or lower from it, or iust in the same, the great circles of the Globe are equallie diuided by the Horizon, except they be conicident, and hid therewith.

P. May they then be hid with the Horizon?

M. Yes,

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M. Yea, there is none of them excepting the Meridian, but in some position of the Sphere it may be iust in the Horizon, and couered with it : as thus for example. If the two poles of the Globe be in the Horizon, the two Tropics interchangeablie are in the Horizon. If the pole be raised 66. degrees 30. min, above the Horizon, the Eclipticke is sometimes couered therewith, namely, when it toucheth the tropicall point, which is next to the pole eleuated, commeth to the North side of the Meridian. Last of all when the pole is in the Zenith equallie distinct on euerie side from the Meridian, then is the equator continuallie in the Horizon. What is to be noted thereby I will declare vnto you hereafter, only marke you my words at this time. Otherwise the great circles are equally diuided by the Horizon : whereby you shall note this touching the equator, that whensoever the Sunne commeth vnto any great circle, the day and the night is of an equall length. So concerning the Eclipticke you see this, that there are alwayes fixe signes aboue, and fixe beneath (sauing that verie moment of time, which I spake of euen before) and therefore when any signe doth rise, the opposite signe doth alwayes set, as if γ arise, π doth set, if ϕ arise, ψ doth arise. And contrarywise, the second thing to be noted, is the vniforme rising and setting of the equator, which (howsoever the Globe be set) riseth and setteth neither faster nor slower at any one time more than at another, whereupon as I sayd before it is the measure of all time, the intire reuolution of it is the measure of 24. houres, and the rising of euerie 15. degrees is the measure of an houre.

P. How shall I induce my selfe to beleeue this vniforme motion of the equator?

P. First

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P. First, the situation of the equator in the middle of the globe between the two poles, may moue you to beleue it : euen as therefore the motion of the heauen is certaine & doth not moue but equally, so doth the equinoctiall moue also. Secōdly, it maketh the same angle with the Horizon in any certaine position of the Sphere without alteration, which thing the ecliptick doth not.

P. How shall I know that ?

M. Raise the the pole of the globe as high as you please above the Horizon, as for example 50. degrees. The angle which the equator maketh with the horizon will be 40. broad, as you may perceiue by the degrees of the meridian intercepted between them bothe. Then turne the globe round, and that angle will still continue of the same quantitie : but the angle which the ecliptick maketh with the horizon will varie diuerslie. Last of all the vniforme rising and setting of the equator, may be perceiued by the houre circle, for if you place it as you were taught before, and apply the index vnto twelue o'clock, and then marke what degree of the equator is on the East or West side of the meridian, in mouing the globe, vntill the Index light vpon one o'clock, you shall finde 15. degrees of the equator to rise, and to set, and consequently it will fall out from houre to houre. And heere I must put you in minde of one thing, that forasmuch as the equator is the measure of time, the young students in Astronomy ought diligently to endeavour themselves to be cunning, and ready to conuert the degrees, minutes, seconds, &c. of the equator, into parts of time, and contrarywise the parts of time into degrees of the equator, the which thing is most easy vnto them that are skillfull in the rule of proportion, for if 15. degr. do ye

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houre, they may easily infer what 30. or 40. degr. &c. yeeld: and againe, if 1. houre giue 15. degr. what shall 2. or 4. houres yeeld, &c. The third thing which craveth no certaine position of the Sphere is the declination: a thing to be noted by all students in Astronomie. Declination is the distance of any thing in the celestiall Globe from the equator measured by the degrees of a great circle drawn from the poles of the world.

P. But what great circle is that, by whose degrees declination is to be measured?

A. It is that great circle which is drawn from the poles of the world through the center of that thing whose declination I would know by the globe. But for so much as it were an infinite and an impossible worke to drawe through euery point assigned a circle, therefore wee make the meridian the common instrument to finde the declination. So that whether wee seeke the declination of any starre in the heauen, or whether we seeke the declination of any point assigned in the eclipticke (which learned also the declination of the Sunne, because the Sunne alwayes possesseth one degree or other of the eclipticke) this is your rule: If you bring the starre or any assigned degree of the eclipticke vnto the meridian, the degrees of the meridian intercepted between the equator & the assigned star or degree, expresse the declination.

P. You say that I must bring the starre or degree assigned to the meridian, but is it no matter vnto which part of the meridian I bring it?

A. Yes, it is a great matter. Here therefore you must remember to minde that which I told you before, concerning applying of the houre circle vnto the meridian. If the axis of the globe come through the midst of the meridian,

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ridian, or be aplyed to the right or left side of the meridian, the starre or degree assigned, whose declination you would know, must be aplyed to the Meridian accordingly, either to the middest, to the right or left side thereof.

P. You sayd before, that the equator was the beginning of all declination, and whatsoever is vnder the circle, hath no declination, whereupon I may inferre this, that the heads of γ and π haue no declination.

M. It is true: but what point soeuer is either on the one side, or the other of the equator, it hath a declination according to the denomination of the pole toward which it declineth.

P. Then all declination is either Northern or Southern, whether it be of the Sunne or Starres. But what is the greatest quantitie that they may haue?

M. The termes and limits of the declination as you haue heard is the equator, and the thing propounded whose declination you would know. The greatest declination therefore of any thing propounded, cannot be more than 90. degrees, because nothing can be farther distant from the equator than 90 degrees, the poles therefore haue the greatest declination, and whatsoever it is that commeth nearest vnto them, hath a greater declination than that which is farther off from them. Whatsoever is nearest the equator, hath the least declination. The chiefest regard of the greatest declination is to the eclipticke, wherein 2. points haue greater declination than all the rest, namely, the heads of $\odot$ and $\sphericalangle$, which decline according to the latter obseruations 23.d. 28.

P. Why hath there bene a difference found in the

M. As there hath bene a difference found in the declination of the fixed starres by reason of the motion

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the ninth Sphere, so in regard of the motion of trepi-
on belonging to the eight Sphere, the Sunne doth
nge his greatest declination. *Ptolemee* founde the
atest declination to be 23. d. 51. min 20. s. *10. Regio-*
ntanus auouched it to be 23. d. 30. min. *Copernicus*
nounced it to be 23. d. 28. m. All the other points of
eclipticke are of a lesser declination, according as
y are nearer to the equinoctiall, and in them this is a
erall rule, that those points of the eclipticke which
opposite, or equallie distant from the equinoctiall
nts haue equall declination, as γ and m . being op-
ite, item γ and χ . or γ and μ . which are of equall
ance from the equinoctiall points, haue equall de-
ation.

P. Hetherto you haue made the Meridian the
nmon measurer of the declination: but may I not
de it otherwise?

M. Yes you may finde it by your compasses more
cisely in this manner: set one foote of your com-
ses in any starre propounded, or in any degree of the
pticke, whose declination you desire, and turne the
er foote of them to the equator, or any other circle
alllell vnto the equator, putting the said foote out, or
lling it in, vtill you do but touch the circle. Then ap-
e your compasses to the equinoctiall line, and obserue
e number of degrees intercepted betweene them, for
ey expresse the declination.

P. What commoditie doth the knowledge of the
clination bring?

M. First, it helpeth vs to finde the heighth of the
e, as I will teach you hereafter when I speake of the
ighth of the starres and Sunne. Secondly, it bringeth vs

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to the knowledge of the place of the Sunne. Last of
it bringeth forth the day of the moneth.

P. Tell mee the declination being knowen (as
example, suppose I know the Sunne to decline 11. de
30.m.) how shall I finde the place of the Sunne?

M. Forso much as 4. meane points of the ecliptic
haue equall declination (as I said euen now) there m
therefore consideration be had of the time of the year
as, whether the Sunne be supposed to haue this decli
tion in the spring, or in the sommer, &c. For the de
nation propounded, must be sought out only in that p
of the eclipticke which is correspondent to the seas
then is your rule this: if the quarter of the eclipticke
swerable to the season propounded, be applied to
meridian, the degree of the eclipticke, which falleth
vnder the assigned declination, is the place of the Sun
so if it be spring time, the Sunne declining 11. d. 30.
must needs possesse the head of γ . if it be sommer,
possesseth the head of η &c.

P. Hereby me thinketh I could answere the
proposition my selfe.

M. Let me see: the declination of the Sunne be
giuen, how can you finde the day of the moneth?

P. If the degree which the Sun possesseth being fou
out by the former proposition, be sought for afterwa
in the horizon of the Globe, the day of the mon
which standeth right against it, is the day required.
for example, the Sunne in the Spring time declineth
d. 30. m. by the former proposition I finde his place to
the head of γ , vnto the which in the horizon of
globe I finde the ende of the tenth of Aprill to answ

M. You saie true: the fourth thing which crav

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certaine position of the Globe is the Longitude: this
may belong to any point assigned in the Globe, but ge-
nerally wee seeke the longitude either of the Starres, or
the degrees of the eclipticke, whereby also wee count
the longitude of the Sunne. The beginning of longi-
tude is the head of γ , the circle wherein it is counted
and measured is the eclipticke. The extremitie or ende
of the longitude in respect of the Starres which are di-
stant from the eclipticke toward either pole thereof, is
that point of the eclipticke, vpon which, that great
circle lighteth, which is drawne from the poles of the
eclipticke through the centre of the starre. But in re-
spect of the eclipticke it selfe, or in regard of any starre,
the sunne supposed to be in the eclipticke, the end or
point of longitude is that degree, which the sunne or
starre is supposed to possesse. Hereupon wee define the
longitude thus. The longitude is an arcke of the eclip-
ticke, contained according to the naturall succession of
the signes betweene the head of γ , and that great circle,
which is drawne from the poles of the eclipticke,
through the point assigned in the Globe. Heere you
must note this, that forsomuch as the head of γ is the
beginning of all longitude, therefore whatsoever is con-
tained vnder the halfe of that great circle, which is
drawne from the one pole of the eclipticke through that
point vnto the other, hath no longitude at all. The other
points assigned in the globe, may increase in longitude
to 360. degrees, than the which there can be no grea-
ter, because they are the degrees of the whole eclipticke.
P. You say, that the longitude is an arcke of the e-
clipticke, but how shall I expresse it: as for example.
I be demaunded of the Longitude of the Starre
called

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called the Lions hart, what shall I say, that it is an arc
of the eclipticke, &c? me thinketh that were somewhat
absurd.

M. If you should answere so your answere were
true: but for your instruction note this, that when we
be demanded of the Longitude of the Sunne or starre
wee make answere two severall waies, sometimes by
degrees of the signe vpon which the great circle falleth
which is drawen from the poles of the eclipticke through
the centre thereof: so wee say, that the Longitude of
Lions hart is the 23. d. 43. m. of Leo. Sometimes we
answere by the continuall succession of the degrees con-
tained in the arcke of the eclipticke, for wee say the Li-
ons hart hath Longitude 143. d. 43. m.

P. But the degrees of the eclipticke are not
downe in continuall succession vpon the Globe.

M. It is true, and therefore the Longitude vpon
the Globe is not found, but according to the signes, and
their degrees. Yet if for euery whole signe you count
30. degrees, and vnto that summe adde the odd degrees
and minutes remayning, if there be any, the totall is
Longitude according to the continuall succession, as
for example, the Lions hart is in the 23. d. 43. m. of Leo.
Before Leo there are 4. whole signes, therefore I take
4 times 30. which make 120. vnto which I adde the odd
degrees, and minutes remayning, which are 23. d. 43. m.
the totall summe 143. d. 43. m. is the Longitude, accord-
ing to the continuall succession of the degrees.

P. You sayd, that in finding the declination,
the meridian circle is a fit and conuenient instrument:
what shall wee haue to finde the longitude.

M. It were conuenient for this purpose and for
latitudes

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uide whereof I am to speake, to haue a semicircle
fast to each pole of the eclipticke when occasion
ould serue, diuided into 180. degrees, so that the quar-
ter from the eclipticke to each pole should containe 90.
otherwise you must vse the quadrant of altitude, ap-
pling the 90. degree thereof vnto the pole of the eclip-
ticke, and bringing the edge of the quadrant through
the centre of the starre. But if you could so order the
matter that the Globe might be taken off from the me-
an, and the poles of the eclipticke fastened thereto
the poles of the equator are, then were it most com-
modious for this purpose, and for the finding of the la-
titude of the starres, which is the fift generall thing to be
done in the vse of the Globe, without any certaine po-
int regarded.

P. What is the Latitude?

M. I told you, that as the equator was the begin-
ning of all declination, so is the eclipticke the beginning
of all latitude in the celestiaall Globe. Whatsoeuer there-
fore is iust vnder the eclipticke, hath no latitude, as the
people who keepeth alwayes vnderneath it. The lati-
tude then which is afforded by the celestiaall Globe, is of
starres that are not vnder the eclipticke, it is defined
Latitude is the distance of a starre from the eclip-
ticke measured by the degrees of a great circle drawne
between the poles of the eclipticke through the centre of
the starre propounded.

P. Therefore if I take the quadrant of altitude, or
halfe circle, which you spake of before, and applic
it to the poles of the eclipticke, bringing it close to
the starre assigned, the degrees which are contained
between the eclipticke, and the starre, expresse the la-
titude

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itude thereof. But put case I wanted bothe of the might I not finde the Latitude by the Compasses?

M. Yes in such manner as I taught you to find the declination. If you set one foote of your compass in the centre of the Starre, and take the shortest extension (as wee call it) betweene the said centre and the cliptick, the degrees of the equator contained between the feete of your Compasses afford the Latitude, which must be pronounced to be either North or South according as it leaneth to the Poles. What Starre ever leaneth from the eclipticke toward the North hath North latitude, and what soever leaneth toward the South pole, hath South latitude.

P. What vse hath the longitude and the latitude

M. They serue to finde out the Starres of the Globe which are easily found if I knowe these two things. I applie the quadrant of altitude to the pole of the eclipticke either North or South as the denomination of the Latitude doth direct me, and bring the ende thereof to the degree of Longitude, the Latitude being contained in the quadrant, will bring me directlie to the place of the Starre. Moreover, wee cannot so conuenientlie make use of the celestiall Globe, or rather wee cannot make it use without the knowledge of the longitude and latitude of the Starres.

P. You haue taught me how to finde out the denomination longitude, and latitude of the Starres, so far forth as they are inscribed in the Globe. Now put case that I should finde in the heauen some Starre which was not in the Globe, may I notwithstanding by the Globe finde out the longitude, latitude, and declination of the Starre?

M.

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M. Yea that you may. Can you tell how to finde distance of Starres?

P. Yea that I can, I learned it at your Lecture when I read your booke concerning the vse of the crosse staffe, and there it is set downe.

M. Then when you espie any starre in heauen not pressed in the celestiaall globe, first make choise of two starres in a reasonable distance fro that which you espy, any two, it maketh no great matter which, only they must not be in a right line with the starre seene, but rather choose them in a triangle. Secondly, take the distance of each starre from the starre newly seene: Thirdly, finde out those two starres vpon your Globe, which you made choise of in the heauen, then extending your compasses at seuerall times, vnto so make degrees of the equator, as the seuerall distance of each starre doth require. Set the one foote of your Compasses in the one starre, whose distance was first taken, and according to that distance make a circumference either vpward or downward, according as the situation of the starre newly found out doth admonish you. Also set the foote of your Compasses in the starre whose distance was found out at the second time, and according to that distance make an other circle which shall crosse the former in one place or an other, the interseccion of those circles is the true place of the starre, whose declination, longitude and latitude may be found by the rules I sayd.

I perceauie your meaning, the practise of it will be profitable, proceede now I pray you to the sixt thing noted in the circles of the Globe, considered together one with an other, without anie certayne

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position of the Globe, which is the finding of the four
cardinall points.

M. This is certaine, that where the meridian cutteth the Horizon, there are the two cardinall points which are called the North and South: and where the equator cutteth the Horizon, there are the other two which are called the East and West: so that if by the helpe of the needle touched with the Load stone you turne the fore part of the meridian to the Southward, the four cardinall points will appeare, howsoever the pole of the Globe be raised more or lesse above the Horizon, so that it be not made your Zenith.

P. Why do you put in that caveat?

M. They that dwell vnder either pole, haue the equator iust in their Horizon, so that it maketh no intersection with the Horizon, and therefore in that respect they cannot say that this place or that place is East or West, but which way soever they looke, it is South vnto them. The last generall thing to be noted of the circles, is the goodnes of the materiall Globe it self. And heere I must tell you this, that concerning Globes, which our countreyman hath made, the board vpon which the printed papers are pasted, is most perfectly round, as by the triall I haue found them, and therefore to say it, that he may receaue commendations for his paines, and artificiall handling of the same. If there be a fault, it is either in the papers or in the Horizon or meridian: which whether it be, the circles bewraie it, in this manner. If the great circles which are drawne from the poles of the world, being applyed to the meridian, do not precisely answere it, and fall vnderneath it, without bowing one way or an other.

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There is a fault in the pasting of the papers, or else the meridian it selfe is crooked. The papers cannot be holden, if the meridian may. If the equator, in the reuolution of the Globe, do not keepe iust vnder the middle of the meridian where the degrees begin, there is a fault in the Globe, for it is a signe, that it sincketh downe to much toward the nethermost pole, or else is rayfed to high toward the vppermost pole. If the equator in the reuolution of the Globe do not rise and fall iust vpon the East and West point of the Horizon, there is a fault as before, or else the papers are not pasted iust in a circle. If the iust halfe of the meridian be not aboue and beneath the Horizon, there is a fault, either in the Horizon it selfe, which warpeth, or else in letting of the meridian into the Horizon, which may be remedied either by raising it higher, or letting it sincke lower. If the Horizon do not cut the equator into two equall peeces, there is the same fault in the Globe also, except the Horizon warpe. Thus haue I deliuered as briefelic as I could those things which are to be considered in the relation of the circles of the Globe iointlie one with an other, without regard had vnto anie certaine position of the Globe, it remaineth therefore now to speake of them which require a certaine position which we commonlie call the rectifying of the Globe.

P. What is it to rectifie the Globe?

M. To rectifie the Globe is so to situate it, that it may be answerable to the heauen, so that the meridian of the Globe, the poles and axeltree, with the Horizon, be answerable to the same circles in the heauen, whether it be a right Sphere as we tearme it, or a crooked.

P. What meane you by a right Sphere & a crooked?

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M. You see this, that howsoever you place the Globe in the Horizon, the equinoctiall either make an angle with the Horizon, or is parallell vnto it, as falleth iust within it. If it make an angle with the Horizon, the angle is either right or oblique. According to this angle the Sphere is called either right or oblique. A right Sphere is that wherein the equinoctiall and the Horizon cut one another at right angles: therefore the poles of the equinoctiall (which are the poles of the world) are in the Horizon, and contrarywise, the poles of the Horizon are in the equinoctiall, so that the equinoctiall passeth both directly ouer our head, and vnder our feete. The Horizon in regard of this concurse at right angles with the equator, is called also a right Horizon. And here you are to note this diligently for your ease in the vſing of the Globe, that the meridian may supply the place of a right horizon, because it hath all the properties thereof. For as the Horizon of a right Sphere cutteth the equinoctiall at right angles, so doth the meridian, as the poles of the world are in the right Horizon, so are they in the meridian: as the right horizon divideth all the circles of the Globe, be they great, or little, into two equall parts, so doth the meridian: whereupon wee take this for a generall rule, that what conclusion euer in the vſe of the Globe is to be tried by the horizon of the right Sphere, the same may with lesser trouble be tried by the meridian.

P. By that which you haue spoken of a right Sphere I may easily gather what an oblique (or as wee term it) a crooked Sphere is, I thinke I may rightly define an oblique Sphere to be that, wherein the equator makes an oblique angle with the horizon: whereupon the

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needes followe as a consequent, that one of the
is alwayes aboue the horizon, and the other be-
h, either more or lesse.

Q. You say true; and therefore this also doth insue,
an oblique Sphere may admit all the degrees of
parifon, that is, it may be oblique, it may be more
que, it may be most oblique. It is oblique when the
is raised neuer so litle aboue the horizon: it is most
que when the pole is raised most aboue the horizon,
is, when the pole is in our Zenith, and the equi-
tiall is coincident with the horizon. The horizon in
rd of this oblique angle made with the equator, is
d also an oblique horizon. Moreouer, you must
e this, that whether the Sphere be right or croked,
arre as the equinoctiall is distant from the horizon,
arre is the pole of the equinoctiall distant from the
of the horizon which is our Zenith. And againe,
arre as the Zenith is from the equator, so farre is the
e from the horizon. If the equinoctiall be 90. de-
es aboue the horizon, the Zenith is 90. degrees di-
t from the poles of the equator. If the equator be
degrees aboue the horizon, the Zenith is 30. degrees
ue the pole. If the equator and the horizon doe
e one with an other, the pole and the Zenith are
he one point.

Q. What am I to learne by this for mine instruction?

A. Hereby you may learne how to set the quadrant
altitude in his due place: for if from the pole vp-
rd you count so many degrees of the meridian, as
contayned betweene the equator, and the horizon:
otherwise, if from the equator vpward you count
many degrees of the meridian, as are contayned

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betweene the pole and the Horizon, there is the place vnto which you must fasten the sayd quadrante.

P. Let vs now returne from whence wee departed. Tell me I pray you, is it alwayes requisite that the Globe should be in situation iust correspondent to the face of the heauen?

M. No. In most conclusions it is only requisite that the pole of the Globe should be raysted according to the pole of the heauen, for otherwise wee cannot attaine to the truth of the question. But the setting of the Globe due North and South by the helpe of the needles, or the setting of it leuell by the plommet line, are alwayes necessarie, when they are necessarie, I will shew you hereafter. The height of the pole must either be giuen, or be sought out.

P. I perceaue your meaning. Now to the purpose concerning the vse of the circles of the Globe, when the Globe requireth a certaine position, or as you called it a rectifying, with which circle shall wee begin?

M. With the Horizon, for either in that, or from that most of the propositions do arise. First of all let us call in question the rising and setting of the Sunne and Starres: the rising and setting of the Starre is to be gathered by the Starre it selfe, the rising and setting of the Sunne is to be gathered by the degrees of the eclipticke.

P. When is a Starre, or the Sunne sayd to rise & set?

M. If the centre of the Sunne or Starre commeth from the inferior Hemisphere do mount aboue our Horizon, he is sayd to arise. If descending from the superior Hemisphere, his centre falleth beneath our Horizon, he is sayd to set. If mounting vpward, or descending downward

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downward, the center doth but touch the Horizon,
is sayd then neither to rise nor set, but is rising.

P. Goe to then, answere me to this, any eleuation
the pole being giuen, how shall I finde by the Globe
what starres do arise and set, what starres neuer set, and
what starres neuer rise ?

M. Reclifie your Globe, that is, rayse the pole of
the Globe according to the eleuation assigned, so shall
it presently answere your selfe by the reuolution of
the Globe. If bothe the poles be in the Horizon, you
shall see euery starre and euery degree of the eclipticke
arise and set. If one of the poles be in your Zenith,
you shall see all the starres and degrees of the eclipticke
from the equator vpward neuer to set, and contrarywise
those that are from the equator downward neuer to
rise. If the pole be rayfed 66.d 30.m. you shall see all the
starres from the one tropicke vpward neuer to set, and
from the other tropicke downward neuer to rise, and
the Sunne being in the tropicke next to the pole that is
elevated, doth but touch the Horizon with his centre,
and being in all other places of the eclipticke, he doth
neither rise, and set. To conclude, this is a generall rule to
be gathered out of the declination. If the declination
of the Sunne or Starre be lesse than the comple-
ment of the heighth of the pole, the Sunne and Starre a-
rise and setteth. If the declination be greater, they ne-
ither set, or else neuer arise. If the declination be equall,
they touch the Horizon, but neuer set, or else neuer a-
rise. The next thing to be considered in the Horizon is
the ascension and descension of the Sunne or Starres,
with the difference thereof. Ascension is the portion of
the equator contained (the orderly succession of the
degrees

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degrees being obserued) betweene the head of γ , and the horizon, at the time of the rising of the Sunne, or Starre. Descension is the portion of the equator contained in like manner betweene the head of γ , and the horizon, at the time of the setting of the Sunne or Starre. Therefore whatsoever is in the horizon with the head of γ , hath neither ascension or descension. Ascension and descension is either right or crooked or otherwise called oblique. Right ascension is the portion of the equator contained betweene the head of Aries and the meridian, at the time of the coming of either sunne or starre vnto the meridian. Descension may be defined in the same manner by the departing from the meridian.

P. How commeth it to passe that you define the right ascension by the meridian and not by the horizon, as you did generally define it before?

M. I define it by the meridian, because I would haue you remember that which I tolde you before, namely that the meridian of the Globe may very fitly supply the place of the horizon in a right sphere. Therefore if you would know the right ascension of the sunne or starre, bring the degree of the eclipticke which the sunne possesseth, or else bring the starre assigned to the meridian, and there obserue what portion of the equator is contained betweene the head of γ and the meridian, that is the right ascension. Heere this is to be noted that the right ascension and descension are alwayes one for the same degree of the equator which commeth to the meridian, the same degree goeth from the meridian with the sunne or starre. Moreouer, there is no degree of the eclipticke, nor no starre, but it hath a right ascension.

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and descension, excepting those which were generally excepted before, namely, those which are iust vnder the meridian with the head of γ .

P. By your words I gather, that the oblique ascension is the portion of the equator contained between the head of γ , and the horizon of an oblique sphere, at rising of the sunne or starres. Descension also may be defined in the same manner by the setting. So that if we desire to know the oblique ascension, I must bring the head of the eclipticke, or else the starre assigned to the horizon, and there obserue what portion of the equator is contained between the head of γ and the horizon, that on the East side of the horizon is the oblique ascension, on the West side it is the descension.

M. You say right. And here note this, that the oblique ascension and descension are neuer the same. Some starres and the sunne likewise haue neither ascension or descension, namely, when they neither rise nor set.

P. What is the difference of ascension which you mentioned before?

M. In searching out the right and crooked ascension, you shall finde this continually to be true, that the right and the same signe or starre the seuerall ascensions neuer agree; the one is alwayes either greater, or less than another: therefore hauing found out the right and crooked ascension of any one starre, subtract the lesser from the greater, the degrees of the equator which remayne, is called the difference of ascension.

P. To what end serueth this ascension, and difference of ascension whereof you speake?

M. It

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P. It serueth to diuers purposes, whereof I haue
make mention hereafter, now let vs follow the manner
which we haue in hand. Wee vse in the Horizon to
serue with what degree of the eclipticke any Starre
doth arise or set, which thing is done only by moving
the Globe vp and downe, vntill the Starre assigned com-
meth to the East or West side of the Horizon, the de-
gree of the eclipticke which is then in the Horizon
the degree required.

P. By this meanes also I may knowe what degree
commeth to the meridian, for if I bring the Starre pro-
pounded to the meridian, the degree of the eclipticke
which is vnder the meridian with the starre, is the de-
gree required. But what dothe the knowledge of this
auaile me?

M. Hereby you may learne vpon what day of
every moneth euery Starre is to be seene rising or
setting, or in the meridian at midnight, in this maner
Bring the Starre propounded to the East side of the Ho-
rizon, marke what degree of the eclipticke is in the Ho-
rizon with it when the Sunne shall possesse the opposite
degree, that day shall the assigned starre arise at the
rising of the Sunne.

P. But how shall I knowe that daye?

M. I tolde you before, that whensoever there
any degree of the eclipticke assigned, it must be found
out in the Horizon, and right against it you shall find
the day of the moneth wherein the sunne possesseth that
degree. Take an example: the litle dogge ariseth in the
Horizon with the 5.d.30.m. of Leo, the degree opposite
to this in the west side of the Horizon, is the 5.d.30.m.
Aquarius, the sunne possesseth that degree as I perceiue

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the Horizon the 16. of Ianuarie, therefore vpon that
at the setting of the Sunne the litle dogge ariseth
the Horizon. Contrarywise, bring any Starre to the
side of the Horizon, marke the degree of the e-
clipticke which commeth to the Horizon with it :
on the Sunne possesseth the opposite degree, on that
at the rising of the Sunne the sayd Starre shall set in
West. And heere is the first meanes offred to finde
elevation of the pole. This is certaine, that there is
elevation wherein one and the same Starre ariseth or
seth with the same degree of the eclipticke with
which it riseth, and setteth in an other elevation, but
a Starre in each seuerall elevation of the pole, hath
uerall degree of the eclipticke, with which it riseth
setteth euery day. If the lesser dogge arise in one
e with the head of Leo, in an other place he ariseth
in the 10. or 20. of Leo. Therefore if you can obserue
Starre rising in the Horizon when the Sunne doth
or setting in the Horizon when the Sunne doth a-
note the day of the moneth in the Horizon, and
degree of the eclipticke answerable to that day: find
also the opposite degree, then if you noted the Starre
rise, bring the Starre to the East side of the Horizon,
raise or depresse the pole of the Globe, vntill the
re and the degree of the eclipticke fall bothe toge-
in the Horizon, for then shall the pole of the
be be at his true elevation.

P. If I noted the Starre to set, I must worke this
clusion on the West side of the Globe.

M. It is so. Moreouer, if you note with what de-
any Starre commeth to the Meridian, seeke out the
osite degree, when the Sunne possesseth that degree,
then

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then at midnight you shall see the starre in the meridian : but wee cannot from hence infer the elevation of the pole, because euery where be the pole higher or lower, the starres continuallie come to the meridian with the selfesame degree of the eclipticke. Heere is occasion offred to deliuer vnto you the cosmicall, achronicall, and helicall rising and setting of the signes and starres, which are not to be neglected of young students, especially such as are conuersant in reading of the Poets, because in many places they can hardlie be vnderstoode, without the knowledge of these things. Cosmicall rising and setting of the starres generally taken, is their ascending and descending at any houre of the day whatsoever. Likewise, wee define generally the Achronicall rising and setting of the signes and starres to be their ascending and descending in the night. But properlie they are applied to that time onlie at which the Sunne doth arise or set. Therefore the degree which the Sunne possesseth being applied to the East side of the horizon, the signe or starres which are then on the East side of the horizon with the Sunne, are said to arise Cosmicallie, and they which at the same time are in the West side of the horizon, are said to set cosmicallie. Furthermore, the degree which the Sunne possesseth, being brought to the West side of the horizon, the signe or starres that are on that side with the said degree, doe set Achronicallie (that is by interpretation in the edge of the night) and they on the other side arise achronicallie. Whereby this appeareth, that what signe or starres soeuer arise cosmicallie, the same doe set achronicallie, and contrarywise. Likewise what starre or signe soeuer riseth achronicallie, the same doe

set

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set cosmically, and contrarywise. The hellicall rising of the starres is their appearance after they haue bin hidden by the beames of the sunne. The hellicall setting of the starres is their hiding by the beames of the Sunne. For this you must note, that the Sunne mouing from the West to the East, doth by litle and litle gather vpon the starres which are Eastward from him, and comming neare vnto them within some 15. degrees, litle more or lesse, according to the quantitie of the starres, by his brightnes he obscureth their light, and then are they said to set hellically. Afterwards the Sunne keeping on his course, leaueth the starres to be seene toward the West, then are they said to rise hellically. By the Globe you shall gather the hellicall rising and setting thus, turne the degree which the Sunne possesseth to the East side of the horizon, the starres which are a litle aboue it, are those which are risen hellically, for the Sunne hath left them to be seene before his rising. Againe, turne the degree which the Sun possesseth to the West side of the horizon, the starres which are a litle aboue it, are those which are ready to set hellically, for the Sunne will come vpon them from the West. The next thing to be noted, is the amplitude of the Sunne or starres.

P. Tel me what it is, how it is diuided, what vse it hath?

M. The amplitude is to be considered at the instant time of the rising and setting of the Sun or starres, and not else. The amplitude is the distance of the Sunne or starres from the true East or West measured by the arcke of the horizon. Therefore you must bring the place of the Sun (that is the degree of the ecliptick which the Sun possesseth) or the starre assigned to the East or West side of the horizon, according as the time requireth, then

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then marke how many degrees of the Horizon are contained betweene the Sunne, or the Starre, and the true East or West point of the Horizon, for those degrees expresse the amplitude. Amplitude is either North or South. North amplitude is the arcke of the Horizon counted from the true East or West Northward. South amplitude is to the Southward. The seafaring men keepe account as I told you before by the points of the Compassse, but it is better to obserue the amplitude by degrees. The Sunne or Starres vnder the equator haue no amplitude, because that circle alwayes riseth and setteth full East and West : for the other points of heauen this is generall, that those which haue equall declination haue equall amplitude, be it to the North, or to the Southward. In a right Sphere the declination and amplitude of the Sunne and Starres is of one quantitie, so that knowing the one, I knowe the other : therefore at any time in traouailing, wee finde the declination and amplitude of the Sunne or Starres to agree together, it is a certaine signe that wee are then vnder the equator, and our Zenith is iust in that circle.

P. Then may I inferre this also, that for so much as the meridian of a right Sphere, & the Horizon may be counted as one, if the distance of the Sunne or Starre from one Zenith be equall vnto their declination, wee are iust vnder the equinoctiall.

M. You say true : in any oblique Sphere the declination and amplitude of the Sunne or Starres doth alwayes differ, for the amplitude doth exceede the declination, yet is it neuer more than 90. degrees. Where the pole is eleuated (as you may perceiue by the Globe) 40. d. 30. min. the amplitude of the Sunne in the tropicall

points

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points, is 90. degrees. Where the pole is in our Zenith, there is no account made of the amplitude, because there is neither rising nor setting of the starres. The vse of the amplitude is in the finding of the elevation of the pole. Each seuerall starre in each seuerall elevation, hath a peculiar amplitude, so also haue the seuerall degrees of the eclipticke, whose declination doth differ. Therefore the amplitude of the Sunne or starre being knowen, if you bring them to the horizon, and rayse the pole of the Globe, or depresse it, vntill the starre or Sunne come to his iust amplitude, the pole shall haue his true elevation.

P. Me thinketh contrariwise I may inferre this: the amplitude being knowen, and the pole hauing his due elevation, to finde the degree which the Sunne possesseth: for that degree which toucheth that amplitude, is the degree of the eclipticke sought for.

M. You say well: but considering that two seuerall degrees in the North part, and two in the South haue equall declination, and therefore equall amplitude, you must in answering this question haue an eye to the time of the yeare, that you may make choise of the signe which is correspondent to the season, according as it hath bin noted heretofore. Moreouer, the amplitude either of the Sunne or Starres being knowen, and the pole of the Globe being raysed as it ought to be, you may finde the variation of the compasse in this manner. Pitch your compasse in some conuenient place, take the amplitude of the Sunne, or any other starre arising or setting, then bring the degree of the eclipticke which the Sunne possesseth or the starre obserued, vnto the horizon of your Globe, if the amplitude found out be

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correspondent to that which the Globe affordeth, then hath your compasse no variation, otherwise the variation is so much, as the difference betweene the obseruation made with your compas & the Globe amounteth vnto

P. But how would you haue the compasse framed for the performance of the conclusion?

M. You may take any how so euer they be made, but for the yong beginner that compasse is fittest which hath the Needle set, iust vnder the North and South point.

P. I pray you tell mee this : the pole being raised as it ought to bee, how shall I finde at what time the Sunne or any other starre ariseth.

M. The rediest way to performe this is by the rectifying of the index belonging to the hower circle.

P. How is the index to be rectified?

M. The degree which the Sunne possesseth being brought to the Meridian of your Globe, and your hower circle beeing fastened to the Meridian orderly, you place the index vpon 12. a clocke, then is the index sayd to be rectified. This thing you shall note diligently, that there bee no more repetition made thereof when soeuer the mention shall be made of rectifying the index of your Globe. The index being rectified if you bring the degree of the Eclipticke which the Sunne possesseth to the Horizon the index will expresse the time of his rising or setting, according as it is applyed either to the East or West side of the Horizon. Likewise the index being rectified if you bring any Starre assigned to the East or west side of the Horizon, you shall finde the time when it riseth or setteth.

P. But put case I wanted mine hower circle, and

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index, may I not find the time of the Sunnes rising and setting otherwise?

M. Yes, you may finde it by the difference of ascension as I will teach you hereafter. Thus much concerning those thinges which are to be obserued when the Sun or Starres are in the Horizon. Now let vs come to those thinges which are to be noted when the Sunne or starres are ether aboue or beneath the Horizon. Among the which, the first to be considered is the altitude of the Sunne or Starres.

P. I pray you let mee haue your instruction in this matter, for I take it to be a thing expedient to be known, because I heare many men bragge of their cunning in taking the altitude of Sunne and Starre.

M. The Horizon is the beginning of all altitude height or eleuation: therefore what soeuer is in the horizon hath no altitude, height, or eleuation. The extreme of all altitude is the Zenith, for nothing can be higher aboue the Horizon than that point, which being 90. degrees aboue the Horizon is equally distant from it in euery side. Moreouer this you must vnderstand, that from the Zenith to each seuerall point of the Horizon a great circle may bee drawen, which because they come from the verticall point, are therefore called verticall circles, in some one of these circles is the altitude to bee counted, whereuppon wee define the altitude to bee the distance of the Sunne or Starre from the Horizon, expressed by the degrees of the verticall circle, which is drawen from the Zenith through the center of the Starre propounded. The instrument seruing for this purpose is the quadrant of altitude which must be fastened as you were taught before vnto the Zenith.

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P. How shall I finde the altitude thereby?

M. Lay the quadrant of altitude vpon the place of the Sunne, or any other degree of the eclipticke, or vpon any starre, and obserue the degrees contained betwene it and the horizon, for they generally expresse the altitude required, the Sunne or starre being supposed to be in such or such a place of the heauen. The altitude of the Sunne or starre is either meridian, or intermeridian. The meridian altitude is the distance betwene the starre and the horizon, when the starre is iust in the meridian, the quantitie whereof is expresse by the degrees of the meridian circle. Therefore if you bring either the Sunne or starre assigned to the meridian, you shall finde the meridian altitude thereof, the pole of the Globe being rayfed to his due heighth.

P. Why doe you put in that caueat?

M. Because as the pole riseth higher or lower, doth the meridian eleuation of Sunne or starres alter. In a right Sphere the meridian eleuation of the Sunne or starres is alwayes equall to the complement of declination: as if the Sunne decline 23.d. 30.min. his eleuation is 66.d. 30.&c. In the most oblique Sphere the meridian altitude is alwayes equall to the declination therefore where the pole is 90.degrees aboue the Horizon, you shall neuer see the Sunne mount higher than 23.d. 30.min. which is his greatest declination. In other situations of the Sphere the meridian altitude is found in this manner. If the Sunne or starre decline to the pole eleuated, the declination of the starre being added to the eleuation of the equator, geueth the meridian altitude: as for example, if the Sunne decline 23.d. 30.min. toward the North pole, the eleuation of the equator being

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being supposed to be 38. d. 30. m. his meridian altitude will be 62. degrees. Contrariwise, if the Sunne or starre decline from the pole eleuated, the declination being taken from the eleuation of the equator, leaueth the meridian altitude : as if the Sunne decline from the North pole 23. d. 30. m. the eleuation of the equator being supposed to be 38. d. 30. m. his meridian altitude will be but 5. degrees.

P. Is there any excellent thing to be gathered by the meridian altitude of the Sunne or starre.

M. Yea, for it bringeth vs to the eleuation of the pole, for considering that each seuerall eleuation of the pole hath a seuerall and peculiar eleuation of the Sunne or starres, therefore by it wee may knowe the eleuation of the pole. If the eleuation of the Sunne or starres be equall to the complement of their declination, then are wee iust vnder the equator, and bothe the poles are in the horizon. If the eleuation be equall to their declination, then are wee iust vnder the pole. The other eleuations of the pole are found by addition or subduction, in this manner. If the Sunne or starre decline toward the pole eleuated, the declination being subducted from the meridian altitude, leaueth the heighth of the equator, which is alwayes the complement of the eleuation of the pole, therefore if you take the heighth of the equator from 90. you haue the eleuation of the pole. If the Sunne or starre decline from the pole eleuated, their declination added to the meridian altitude, geueth the heighth of the equator, and consequently the heighth of the pole.

P. But what if the Sunne or starre haue no declination?

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M. Then is this a generall rule, that the Sunne or Starre is then in the equator, and therefore the Meridian altitude expresseth the height of the equator, which being subducted from 90 geueth the pole. Thus much concerning the meridian altitude of the Sunne or Starre. The intermeridian altitude is the distance of the Sunne or Starre from the Horizon, when they are in some other place of heauen, and not in the meridian: This altitude is either antemeridian or postmeridian. The antemeridian altitude is the distance of the Sunne or Starre from the Horizon at any time before noone: the postmeridian altitude is the distance of the Sunne or Starre from the Horizon after noone. And for so much as the Sunne or Starre by their proper motion make but small difference in their place, so that it cannot sensibly be perceaued in the after noone, that they haue moued from that place wherein they were in the forenoone therefore we say that the antemeridian & postmeridian altitude of the Sunne or Starres is all one, this being supposed that they bee equally distant from the meridian. In searching out the antemeridian or postmeridian altitude of the Sunne or Starres the rule is all one with that generall rule which I gaue you before, so that the Sunne or Starre be supposed to be in any place about the Horizon betweene it and the Meridian.

P. But put case that I did not suppose the Sunne or Starre to bee in any place, may not I finde out by the Globe their certaine and true altitude which they haue in heauen.

M. This you must vnderstand that some thinges are found out immediatly, some things mediately by certain meanes. If the Sunne shine hee will bewray his own

height

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height by the helpe of the ſpherical gnomon, but the height of the ſtarres cannot ſo bee found out; for they require the knowledge of the houre or ſome other ſuch like thing, as you ſhall perceauē hereafter.

P. Tell me then, how ſhall I finde the height of the Sunne by the ſpherical gnomon.

M. Rectify your Globe perfectly in the open aire where the Sunne ſhineth, ſo that it may ſtand precisely North and South, and that the Horizon be leuel, and the pole raiſed as it is conuenient: ſet your ſpherical gnomon vpon the place of the ſunne, on the Eaſt or Weſt ſide of the globe, according as the time requireth, and turne the globe to and fro vntill the gnomon geue no ſhadow: the if you faſten the globe, that it moue not, & bring the quadrant of altitude ouer the place of the ſunne, the degrees therof intercepted between the place of the ſunne, & the Horizon wil expreſſe the true height of the ſunne. Thus much concerning the altitude of the ſun or ſtarres.

P. Now teach me how I may know how long they continue aboue the Horizon.

M. Here you muſt note this, that for ſo much as the ſunne is the efficient cauſe of the day, therefore to know how long he continueth aboue the horizon is to know the length of the day, which is found in ſeueral manners, Firſt thus. Bring the degree which the ſunne poſſeſſeth to the Eaſt ſide of the horizon, then rectify the index, ſetting it vpon 12. a clock in the houre cicle. Turn the globe about vntill the ſaid degree come to the Weſt ſide of the Horizon: the hours (which the index runneth ouer) expreſſe the continuance of the ſunne aboue the Horizon: in like maner may you finde how long any ſtarre continueth aboue the Horizon.

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The second way to finde out the continuance of the Sunne or starre aboue the Horizon, is by the difference of ascension taken twise.

P. Why doe you take the difference of ascension ?

M. This you shall perceau by the Globe, that in a right Sphere there is no point of heauen which doth not rise and set within the space of 12. houres, so that the day is neuer longer than 12. houres, neither doth any starre continue aboue the Horizon longer than that time. But in an oblique Sphere (if the Sunne or starres be not in the equinoctiall) the day is either longer or shorter than 12. houres. If the Sunne or starres decline toward the pole eleuated, their continuance is longer, if from that pole their continuance is shorter aboue the horizon than 12. houres, by the difference of ascension twise taken as I finde before.

P. But why take you this difference twise ?

M. The one declareth how much the Sunne or any Starre ariseth sooner or later in an oblique, than it doth in a right Sphere, the other telleth how much sooner or later it setteth, and thereupon wee frame our rule thus, if the difference of ascension of the Sunne or starre declining toward the pole eleuated be twise taken and added to 180. degrees, the totall summe conuerted into houres and partes of houres as occasion offereth, shall declare the continuance of them aboue the ground. Again, if the difference of ascension of the Sunne or starre declining from the pole eleuated be twise taken and subducted from 180. degrees, the remainder conuerted into houres &c, declareth their continuance aboue the ground.

P. The length of the day being found, what may

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be inferred thereupon.

M. Many things both pleasant, and profitable in Astronomie, as the eleuation of the pole. If the day be continuallie but 12. houres long, then are wee precisely vnder the equator. If the day be 6. moneths long, then are wee directlie vnder the pole. The other eleuations are found out thus. Diuide the length of the day into two equall partes, and conuert the houres into degrees, as if the day be 16. houres long, the halfe thereof is 8. houres, which containe 120. d. From the head of Aries count these degrees in the equator to the West side of the Horizon, and set fast the last degree vnder the meridian, so that it stirre not from it : then in the equinoctiall colure count the declination of the Sunne for the day propounded either vpward or downeward from the equator, according as the place of the signe requireth. Last of all, rayse or let fall the pole of the Globe vntill the degree of declinatiō doth touch the Horizon, so shall the pole haue his iust eleuation, the like may be done by any fixed starre. The second thing to be noted in knowing the length of the day, is the time of the Sunnes rising or setting, for if the length of the artificiall day be diuided into two partes, the one declareth the houre of his setting, the other being subducted from 12. affordeth the time of his rising : as if the day be 16. houres long, he setteth at 8. and riseth at 4. a clocke. The like may be done concerning the rising and setting of the starres. The third thing is the length of the night : for the length of the day being subducted from 24. houres, yeeldeth the length of the night.

P. But may not these three last things be performed by the Globe it selfe?

M. Yes

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M. Yes very conueniently I taught you before how the time of the sunne his rising & setting may be found out. The length of the night is knowen in this manner. Seeke out that degree of the eclipticke which is opposite to the place of the sunne: Bring it to the East side of the horizon, set the index of the houre circle vpon 12. clocke, turne the Globe about vntill the said degree touch the horizon in the West, the houres which the index hath passed ouer, expresse the length of the night. The fourth thing to be gathered out of the length of the day being knowen, is the length of the planetarie houre. The planetarie houre is the twelfth part of the artificial day or night: therefore sometimes it is longer than the common houre, sometimes shorter, sometimes equal vnto it, in a right sphere, the cōmon houre and the planet houre, both of the day & night are equall, in an oblique sphere if the sunne decline frō the pole eleuated, the common houre of the day is lesse than the planetary houre, but the cōmon houre of the night is greater: contrariwise if the sunne decline toward the pole eleuated, the common houre of the day is greater than the planetary houre, but the common houre of the night is lesse. The next conclusion is to finde the houre of the day by the sunne shining.

P. Why do you say by the sunne shining, may not the houre be found, if he shine not, or may it not be found by the starres.

M. If the sunne shine, he leadeth vs vnto the knowledge of the houre by his light, but if he shine not, there must bee one thing or another granted, and geuen, otherwise wee cannot come to the knowledge of any particular thing be it houre, or height, or coasting: the like is to

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be said of the starres whose beame being so weake, that it cannot make a shadow, inforceth vs to craue some one thing granted vnto vs, before wee can inferre any conclusion.

P. I perceau your meaning, first therefore tell me what I may doe by the shining of the sunne: and then I will craue the other conclusions.

M. The hour of the day by the sun shining is found thus, Rectify your globe perfectly, seeke out the place of the sunne, and rectify the index, bring the place of the sunne ether to the East or West side of the meridian according as the time of the day shall aduise you, set the sphericall gnomon vpon it, and turne the globe to and froe vntill the gnomon cast no shadow, then will the index in the houre circle giue the houre of the daye. Now marke how many thinges followe vpon this worke: First, so soone as you haue found the houre, if you fasten the Globe that it stirre not, and bring the quadrant of altitude ouer the place of the sunne, you shall finde his altitude aboue the Horizon. Item the globe being fastened, and the quadrant of altitude being brought ouer the place of the Sunne, you shall finde vpon what point of the compasse he is, with his distance ether from East, West, North, or South. Item, the houre being found: you haue all the Starres aboue the Horizon at that houre. Item you may by the Globe perceau what Starres are in your Zenith at that time. Item, if you note what point of the Eclipticke is vnder the Meridian, both aboue and beneath the Horizon, and also what point of the Eclipticke is in the East and West, you may thereby very well knowe the foure Cardinall pointes of Heauen, as wee terme them, and

confe-

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consequently the beginnings and endings of the 12. houses of heauen which is commonlie tearmed the erecting of a figure.

P. All that you haue mentioned before is easie, but I do not perceauē this last conclusion.

M. I will helpe your vnderstanding so well as I can. First therefore a figure, as wee take it commonlie in this sence, is the diuision of the heauen into 12. parts by certaine great circles drawn from the intersections of the meridian and the horizon, through equall partitions of the equator, diuiding the eclipticke into 12. vnequall partes. Each part of heauen thus diuided is called an house. The beginning of them is in the East, and from thence the rest are accounted vnder the horizon to the nether part of the meridian, and from thence vpward to the West, and so by the South side of the meridian to the East againe, for so the reuolution of the heauen requireth. The instrument whereby the houses are found out, is that halfe circle which we commonly call the circle of position wherof I spake before. The manner of finding the out is this. The houre being knowne by the shining of the Sunne, the 4. cardinall points doe straightway offer themselues, whereof that which is in the East is called the first house, that which is vnder the horizon in the meridian is the fourth house, that which is in the West is the seuenth house, and that in the South part of the meridian is the tenth house. These being noted seuerally according as you see in the figure following, from the point of the equator, which is vnder the meridian, you shall count 30. degrees toward the East, ouer the thirtieth degree bring the circle of position, and note what point of the eclipticke it crosseth, for that is the

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the beginning of the eleventh houſe, and the degree opposite vnto that degree of the eclipticke is the beginning of the fiſt houſe. Againe, from the point of the equator, which is vnder the meridian, you ſhall count 60. degrees toward the Eaſt, and ouer the ſaid 60. degree bring the circle of poſition, and note what point of the eclipticke it lighteth vpon, for that is the beginning of the twelfth houſe; and the opposite degree of the eclipticke vnder the Horizon is the beginning of the ſixt houſe. The beginning of the ninth and eight houſe are found out in the ſame manner on the Weſt ſide of the Globe, as the eleventh and twelfth houſe were found out on the Eaſt ſide. The beginning of the ſecond houſe is the degree opposite to the eight houſe, and the degree opposite to the ninth houſe is the beginning of the third houſe.

P. Is there any thing elſe to be found out by the ſhadow of the ſphericall gnomon.

M. The Sunne being in the meridian, the heighth of the pole may be found out thus. Rectifie the Globe precisely in the open aire, not regarding the eleuation of the pole, bring the degree of the Sunne vnto the meridian, ſet the index vpon it, if it caſt no ſhaddow, then is the pole of the Globe at his due heighth. If the gnomon caſt a ſhaddow, the pole of the Globe is either higher or lower than it ſhould be, and therefore muſt it be rayſed, or let fall.

P. But how ſhall I knowe when I am to rayſe it, and when to let it fall?

M. If the ſhaddow runne toward the pole eleuated, you muſt rayſe the pole of the Globe, if it runne from the pole toward the equator, you muſt let the pole fall.

P. Is

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P. Is there any thing to be gathered out of the former proposition, touching the variation of the compasse.

M. Yea, for if you remember it, I told you, that when the spherical gnomon casteth no shadow, then doe wee finde not onely the houre of the day, but also the coasting of the Sunne, that is, the point of the compasse vpon which hee shineth: Compare therefore your Compasse with the Globe, and you shall easily finde, whether it doth varie yea or no, and how much the variation is, so that the Globe bee rectified precisely as it ought to be: for if the Sunne shine vpon the same point of your Compasse, vpon which the Globe signified him to bee, then hath it no variation at all, but if they differ, their difference will expresse their variation. Thus much concerning those conclusions, which may bee performed on the Globe by the shining of the Sunne, and the Sphericall Gnomon. Let vs now come to those propositions, which require a certaine supposition, or the granting of some one thing or another, and may bee performed without the sunne shining: as thus, for example. The houre being giuen to finde the height that the Sunne shall haue, at that same houre. Rectifie your index, turne the Globe either to East, or West side of the Horizon, according as the houre assigned doth require, vntill the index fall vpon the sayd houre, then fasten the Globe, and bring the quadrant of altitude ouer the place of the sunne, the degrees of it intercepted betweene the place of the Sunne, and the Horizon, expresse his height at that houre.

P. Here me thinketh I may reuerse the former proposition

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position, and by the height of the sunne giuen, I may finde out the houre.

M. You say well, for if you rectify your index, and moue the globe to and froe as the time requireth, vntill the place of the Sunne fall vpon that degree in the quadrant of altitude, which you supposed the sunne to haue, then will the Index expresse the houre.

P. May I not also by the height of the starres finde the houre of the night?

M. Yes, if so be you know the starres of heauen, & can compare them with your Globe.

P. Put case I did know them (for afterwards I will bee bold to craue the knowledge of them) how shall I finde the houre of the night.

M. Take the height of some knowen starre, rectify your index, turne the globe about vntill the same starre sounde out in your globe, haue the same eleuation in the Quadrant of Altitude, which you founde him to haue in the Heauen, so shall the Index expresse the houre.

P. Here also I may inferre this proposition. The houre of the night being giuen to finde not only what height the starres shall haue aboue the horizon, but also what starres are then aboue it.

M. You may, in this manner: rectifie your index, turne your Globe about, vntill the Index fall vpon the houre assigned, so shall you haue the starres in your Globe answerable to them which are seene in heauen: then applying your quadrant of altitude vnto them, you shall finde the height of each seuerall Starre.

Nowe marke you well how many thinges followe hereupon. By this meanes you may come vnto the knowledge

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knowledge of the starres, especially if you set the Globe North, and South, for then the Globe will be so answerable to the heauen, that you cannot but knowe the starres of the heauen by the starres of the Globe, for that starre in the Globe which in place and height is answerable to the like starre in heauen, affordeth the name and title thereof. Item, the houre being found by the starres height, or the height being found by the houre, as I taught you euen now, if you fasten the globe and bring the quadrant of altitude ouer the center of the starre, you shall finde vpon what point of the compass any starre is, and how many degrees it is distant from either of the foure cardinall points of the Horizon. Item, you shall finde the culminant starres, that is, the starres which passe ouer your Zenith. Item, you may thus finde the foure cardinall points of heauen, with the beginning of the twelue houses, and how farre the Sunne is distant from the Horizon, according as I demonstrated it before, in speaking of finding the houre of the day by the Sunne.

P. But may the height of the pole be found by the starres, as it was found by the Sunne?

M. It cannot be found by the shaddowe of the sphericall gnomon, because the beame of the starres is so weake, that it cannot cause a shaddowe, but the meridian altitude of any starre being geuen, the height of the pole is presently found by the Globe in this manner. Bring the starre whose meridian altitude is knowne vnto the meridian of the Globe, either to the North, or South side thereof, as the starre it selfe doth admonish you, then rayse, or let fall the pole of your Globe, vntill there be so many degrees of the meridian contained between

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betweene the centre of the starre, and the horizon, as the height found out amounted vnto, so shall the pole of the Globe haue his due elevation.

P. Let vs now returne to our former purpose: you said euen now that by supposition of some one thing or another, many conclusions may bee performed by the Globe without the sight, or shining of the sunne, or starres as you shewed it by example in supposing the height of the sunne, or starres to be knowen, or the hour of the day, or nighte, and from thence you deriued many other conclusions. Haue you anie other proposition tending to the same effect?

M. Yea there are many, for out of any one thing almost all the other may arise; because there is in them a certaine reciprocation, & a necessarie consequence from the one vnto the other: as thus. If the hour be knowen, & the height of the sunne, we may finde his place: the index being rectified.

P. That may bee easily done by the height of the sunne at twelue a clocke hauing consideration of the season of the yeare, because in each quarter of the eclipticke each seuerall degree hath a certaine altitude in the meridian. But how it should be done at any other houre either before, or after noone, I do not see.

M. You must suppose that when your index was rectified, you did then knowe the place of the Sunnes: but when you went about to take his height you forgot: if therefore you desire to know it againe, turne the Globe to and froe, vntil you bring the index to the houre assigned, fixe the Globe and apply the quadrant of altitude to the ecliptick, that degree of the eclipticke, which vnder the quadrant of altitude answereth to the height

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of the Sunne knowen, is the place of the Sunne. Which beeing founde, wee may proceede by a necessary consequence to all the former conclusions whatsoever. As to the point of the compasse vpon which he shineth, to his distance from the East, West, North, or South, &c.

P. Then if I perfectly knowe the distaunce of the Sunne from the Easte, or Weste, together with his height, I may finde his place in any eleuation of the pole.

M. You may, hauing consideration of the time of the yeare, which is alwayes requisite in these propositions, which leade vs to the place of the Sunne. For if you sette the Quadrant of altitude to the point of the Compasse, vppon which the Sunne is sayde to shine, or vppon that distaunce from the true Easte, or West, which the Sunne is sayde to haue, and turne that quarter of the ecliptick which the time of the yeare requireth, vnto the quadrant of Altitude, that degree which vnder the Quadrant answeareth to the supposed height of the Sunne, is the degree which the Sunne possesseth. Contrariwise wee may by the place of the Sunne, and the point of the compasse, vppon which hee shineth, finde the height of the Sunne.

P. Mee thinketh that that is easie: for if I set the Quadrant of Altitude agaynst the point of the Compasse assigned, and bring the place of the Sunne vnto it, the degrees of the Quadrant containd betwene the place of the Sunne, and the Horizon expresse his height.

M. You say true: this proposition also is performe

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ned with the same facilitie. The point of the Compasse beeing giuen, and the place of the Sunne to find the houre of the Daye, in this manner. Rectify your Index, set the Quadrant of Altitude vppon the point of the Compasse assigned, then bring the place of the Sunne to the edge of the Quadrant, so shall the Index expresse the houre.

This also is another consequent: the point of the compasse beeing giuen, and the height of the Sunne to finde the time of the rising or setting: you knowe that the point of the compasse, and the height of the Sunne must necessarily leade vs to his place, hauing found his place, rectify the Index, then bring the place of the Sunne to the East side of the Horizon, so will the Index point out the time of his rising: againe turne the place of the Sunne to the West side of the Horizon, and the index will expresse the time of his setting.

P. I find it now true which you sayd before, namely that the supposition of some certaine things bringeth the consequence of all the other. For mee thinketh that I my selfe knowing the point of the Compasse, and the height of the Sunne, coulde easilie inferre by your example the declination, the right and crooked ascension of the Sunne, the length of the day, or night, the meridian Altitude, and whatsoever hath beene spoken of before. For the height of the Sunne, and the point of the compasse, vpon which he shineth leadeth me to the place of the Sun, the place of the Sun being brought to the meridian geueth his declination, & also his right ascension, and his meridian altitude likewise the same place being brought to the Horizon affordeth his crooked ascension, then keeping the place of the Sunne

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at the horizon, if I set the index vpon 12. a clocke, and turne the Globe about to the West, I cannot but finde the length of the day: &c. Let vs now proccede.

M. Hetherto you haue heard those cōclusions which may be inferred by the Globe, the Sunne or Starres being supposed to bee either in the horizon or about it: there are some which belong to the Sunne or Starres, being vnder the horizon, Among the which 3. or 4. only are vsually sought after: the other either because they are not greatly profitable, or because they are easily performed by that which hath bin deliuered heretofore, are neglected. The first of them is to finde the depression of the Sunne at anie houre assigned: but especially at midnight.

P. What meaneth the depression of the Sunne?

M. The depression is opposite vnto the altitude: and it is the distance of the Sunne from the horizon downward, it is found thus: Seeke out the degree of the eclipticke opposite vnto that degree, which the Sun possesseth, bring it to the South side of the meridian aboue the horizon, the degree of the meridian betweene it and the horizon expresse the depression of the Sunne at midnight. Whereby is gathered how he is vnto them which are our antipodes.

P. But put case I would know the depression of the Sunne at any other houre, how shall I find it?

M. Bring the opposite degree vnto the meridian, rectify the index, turne the Globe about vntill the index fall vpon the same houre, fasten the Globe, & then bring the quadrant of altitude ouer the sayd degree, the portion of the quadrant betweene it, and the horizon expresse the depressiō of the sunne at the hour assigned.

The

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The second concerneth the dawning of the day. That is found in this manner. Bring the degree of the Sunne to the meridian, rectify your index, then seeke out the degree of the ecliptick opposite to the degree which the Sunne possesseth, moue it toward the West side of the Horizon, and by the helpe of the quadrant of altitude let it 18. degrees aboue the Horizon, the houre vpon which the index falleth, expresseth the dawning of the day.

P. I pray you tell mee this, what is the reason why you bring the opposite degree to the West side of the Horizon?

M. As before in seeking the depression of the Sun, the opposite degree being brought to the South side of the meridian declared how low the degree of the Sunne was vnder the Horizon in the North side, euen so here the placing of the opposite degree 18. degrees aboue the Horizon in the West, causeth the true place of the Sun to be 18. degrees vnder the Horizon in the East, at which distance the dawning doth beginne.

P. What if the opposite degree cannot haue 18. degrees of eleuation, but falleth vnderneath it.

M. Then must you conclude, that the twilight continueth from the setting of the Sunne vntill his rising.

P. Is the dawning of the day in all places at the same houre the Sunne possessing one and the same degree?

M. No, for the more oblique the sphere is the dawning beginneth so much the sooner, because the Sunne recepeth his course continually nearer to the Horizon, & therefore lighteneth our hemisphere so much the sooner.

The third conclusion concerneth the length of the dawning

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ning, which is the time from the first breaking of the day
vnto the ryfing of the Sunne: the conclusion is wrought
thus, Seeke out by the former proposition the time of
the dawning, then seeke also the time of the Sunne
rising, the difference of these two times expresse the
length of the dawning, which is more or lesse according
to the obliquitie of the Sphere. The fourth conclusion
concerneth the length of time wherein any signe
ariseth aboue the Horizon.

P. What, is one signe longer arising than another
I thought that as they were all equall, so the time of
their rising or setting was also equall: and this is cer-
taine, that any fixe Signes arise and sette in 12. houres

M. That is true, if you take them ioyntly together
otherwise being taken seuerally, the one is longer a-
rising than the other: wherevpon there ariseth another di-
stinction of ascensio, which in respect of the time limited
vnto each signe is said to be right or oblique without re-
spect had to the situation of the sphere as it was before.
Those signes haue a right ascension, with whom there
arise more than 30. degrees of the equator: that is to say
that are longer arising than 2. houres, contrariwise if there
arise with the signe fewer than 30. degrees of the equator
that is to say, if the signe arise in lesser time than 2. houres
then is that called an oblique ascension. Either of these as-
censions may be found out 2. seueral wayes: by the de-
gree of the Equator, for that is the measure of all time, or
els mechanichally by the houre circle. By the degrees of
the equator, the length of time, that is the ascensio of any
whole signe is found thus in any situation of the sphere.
Bring the hed of any signe to the East signe of the hori-
zon, marke what degree of the equator is in the horizon

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with it, the moue the globe, vntil the end of the ſaid ſigne cometh to the horizon, mark the degree of the equator in the horizon, ſubduct the leſſer from the greater, the remainder conuerted into houres, and minutes if neede require expreſſeth the aſſention of the ſigne propounded: By the houre circle the length of time wherein any ſigne ariſeth is thus ſought out. Bring the hed of any ſigne to the Eaſt ſide of the horizon, ſet the index vpon 12. a clock, moue the globe weſt ward, vntil the end of the ſaid ſigne come to the horizon, the index in the houre circle will expreſſe the length of time wherein the ſigne did ariſe. Theſe are the chiefſt queſtions moued concerning thoſe thinges which happen vnder the horizon.

P. I pray you hath the circle of poſition no other uſe then to rectifie a figure.

M. Yes, for it findeth that circle whereof it receaueth his name, that is the circle of poſitiō, which is but a great circle drawn frō the one interſectiō of the horizon and meridiā, vnto the other, through the centre of ſome ſtar, or any point els aſſigned in the heauē, diuiding the ſphere into 2. peeces. By it in erecting of the 12. houſen, we find what notable ſtarres, or what planets are in any of the houſen. The diſtance of any circle of poſition from the meridian is found thus. The circle of poſition being raiſed frō the horizon vnto any point aſſigned in the globe, moue the quadrant of altitude (fixed to the Zenith) to the eaſt or weſt point of the horizon as occaſion requireth: the degrees of the quadrant contained between the ſaid circle of poſition & the meridian expreſſe the quantity of the angle which it maketh: each circle of poſitiō may ſupply the place of halfe an horizon, & in that reſpect it hath ſingular uſe in aſtronomical & geographical matters, as

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shall be declared, if God spare me life and ability to performe that which I haue in hand. It remaineth now to speake of the lesser circles of the Globe.

P. But by your leaue sir, you haue sayd nothing of making the dials by the Globe: which is a matter mentioned by all Astronomers in handling the vse of the Globe.

M. It is true, and therefore I did omit it, because it is the matter which I haue now in hand, the which I am so much the more desirous to performe, because it hath binne earnestly required by a friend of mine, whose forwardnes in these studies I would helpe so much as lyeth in me. Therefore let me at this instant craue pardon for that matter, vntill such time as I shall particularly discourse thereof,

P. Well then proceed in the vse of the lesser circles of the celestiall Globe.

M. You see that the foure lesser circles of the globe diuide the whole surface thereof into 5. partes. Euery one of them is called a Zone.

P. What meaneth that word Zone?

M. It signifieth among the Grecians a gyrdle, or a swadling band, and therefore it is fitly applyed vnto these portions of the globe, because they in their figure represent after a manner such a thing. Of the Zones some are enclosed with one onely limit some with two: those which are inclosed with one only limit, namely with the circle arcticke, and antarcticke are the two Zones which lie about each pole, which because of their distance from the eclipticke, and place of the sunne are called cold. Not that there is ether heate or colde in heauen, but because they which dwell on earth vnder that circuit of the heauen,

Terrestriall Globe.

uen, feele not the Sunne so forceable in his heat by reason of his obliquitie, as others doe. The other 2. Zones are limited on each side: That which is in the middest, being limited on the one side with the tropick of Cancer, on the other side with the tropicke of Capricorne, is called the burning Zone, because the Sunne keeping his course continually within it doth greatlie heate that part of the earth which is subiect vnto it. The other two being nether too neare the Sunne, nor too farre off are called temperate, because they are nether so hot as the one, nor so cold as the other: that which is to the Northward is limited with the circle arcticke, & the tropick of Cancer, the other to the Southward is enclosed with the circle antarcticke, and the tropicke of Capricorne: The breadth of each cold zone is 47. degrees: the breadth of the burning Zone is as much: each temperate Zone hath 43. degrees in breadth. As they are described on the celestiaall globe, they expresse vnto vs what starres are enclosed within each seuerall Zone, which are to be noted, because they adde somewhat according to their nature vnto the quality of the Zone making it more hot or cold. Thus much concerning the vse of the celestiaall Globe, wherein if I seeme to haue bin ouerlong, I doe therefore craue pardon, because I haue witten it for the behoofe of our cuntry men, who being not thoroughly seen in the Latine tongue might from hence gather that in some measure, which might further their knowledge, and satisfy their desire in these kinde of matters.

The



The vse of the Terrestriall Globe,



VE are now come *Philomathes*, to the terrestriall Globe, whose vse I am so much the more desirous to teach you, by the more I find you willing to learn: follow you therefore your accustomed manner in moving of questions, & I will endeuor my selfe to shap you an answer to your demaund: for so I iudge it best for your instruction.

P. Seeing it is your will I should doe so, I pray you tel me, what mean you by the terrestriall Globe, & how do you define it?

M. The thing it selfe telleth vs, that we may define it to be a solide round bodie containing in the cōuexity thereof the description of the land, and sea, with certaine lines necessarie thereunto.

P. For so much as I haue now the definitions of the two Globes before I goe any further to the vse of this: tell me wherein the celestial and terrestriall Globe agree, and wherein they differ?

M. Concerning their agreement: first you see they haue their forme common, for they are both round.

P. It is so: but herein mee thinketh the terrestriall globe is faulty, because it doth not represent the true forme of the earth, as the celestiall globe doth resemble the heauen, for the earth is not round,

M. Take heed what you say *Philomathes*, the round

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nes of the earth both in breadth & length is so substanti-
ally confirmed, that he is almost accouſted an hereticke a-
mong the geographers that denieth it. Their arguments
are ſet, not only frō the proportion, but alſo frō the man-
ner of the riſing & ſetting of the ſtarres, & the raiſing &
depreſſion of the poles. Item beſides the eclipse of the
moone & the natural courſe of the water, that which ap-
peareth to our ſight in going from, or comming neere
the ſhore, is an euident token of the foreſayd roundnes.

P. But for all theſe arguments I ſay, that the globe
doth not represent the iuſt forme of the earth, which be-
ing full of hilles & dales doth greatly diſagree from a per-
fect round. yea my ſight alſo witneſſeth ſuch a thing, for
which way ſoeuer I looke, both the water and the earth
for the moſt part ſeemeth playne.

M. It is ſomewhat *Philomathes* which you ſay,
but there are diuers reaſons which moued the Cosmo-
graphers in ſetting forth the terreſtrial globe, to do that
which they haue done, that is, to make it rounde. Firſt
becauſe it was not neceſſary to make theſe hilles & dales,
it was ſufficient to expreſſe their place, & to ſay the truth
it was vnpoſſible to ſet them forth as they are indeede.
Secondly, the earth in regarde of the heauen doth not
ſeeme otherwiſe than rounde: as you may perceauē by
the ſhadow thereof, which in the eclipse is moſt ſpheri-
call, & round: thirdly, theſe hilles and dales in regarde
of the whole earth, are but as a mole, or wart vpon a
mans bodie, or the ſmall pimples on an orange. And as
for the playnes which I ſee, bee it either on the water or
land, it ariſeth of the huge circuit of the earth, which is
ſo great, that each parte thereof which wee ſee, cannot
but ſeeme vnto our ſight to be a right line.

P. Well

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P. Well then the first agreement of these 2. globes is in their forme, they are both round, albeit the earth be not to be conceaved to be so precisely round as the heaven is. In what else doe the Globes agree?

M. They haue the same poles, the same axletree, the same imaginarie circle, So that what conclusion soeuer may be performed by any of these on the celestiall Globe, the same may bee performed on the terrestriall Globe, excepting those propositions which concerne the fixed starres.

P. I thought that these thinges had belonged especially to the celestiall Globe.

M. So they doe: but they are therefore expressed in this, because the globe of the earth and water being contained within the heaven, and being in respect the centre thereof, wee may hereby gather what part thereof is subiect to any part of the heaven. Thus much concerning their agreement, their difference appeareth first in their inscription, as their seuerall titles do import, the one containing the starres of heaven, & the circles thereof, the other expressing the earth and water. The second difference consisteth in the manner of the description. For as I told you, the starres which wee beholde in the concavities of heaven are described on the conuexity of the celestiall Globe: but in the terrestriall Globe the earth is described on the outside euen as wee behold it. The third difference is in certaine circles and lines expressed in the terrestriall Globe, but not in the celestiall, namely the circles of longitude and latitude, and the Rhombes.

P. Doe you not mistake your selfe: there are in the celestiall Globe circles of longitude and latitude, for otherwise

Terrestriall Globe ○

herwise how should wee finde the longitude and latitude of the starres?

M. Put case it were as you say (which is seldom or neuer seene) that the circles of longitude & latitude were described on the celestiall globe: yet are they not the same with those of the terrestriall Globe, for the longitude & latitude in both these Globes is not accounted in one kinde of circles, as I will declare vnto you, when I shall haue occasion to speake of the vse of this Glóbe. This shall suffice for the difference of the Globes which consisteth in these foure thinges. 1. In the generall subiect matter. 2. In the manner of describing the same. 3. in the circles of longitude and latitude. 4. in the Rhombes. Let vs now come to the vse of the Globe, wherein I will proceede euen as the subiect matter inscribed doth. afford, not meddling with any of the former conclusions set downe in the vse of the celestiall Globe, but speaking of those thinges only which the terrestriall Globe doth inscribe vs vnto.

P. Goe too then: what doe I learne by the circles of the Globe, first by the equator?

M. It deuiderh the earth into 2. peeces, the North and South: the North is that which is from the equinoctiall round about subiect to the North pole, the South is that, which is from the equinoctiall round about toward the South pole.

P. Do you say then that al they which are betweene the equator and the North pole, are the northren people, and so likewise of any seuerall place?

M. Yea that I doe, what thinke you of myne assertion.

P. I can hardly thinke it to be true: for then why doe

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doe wee call Cape Saint Vincent the South Cape? and why doth the Scripture call the Queene of Saba the Queen of the South, seeing they be both on this side the equator?

M. You must note this, that North and South are not taken after our maner of way: neither East or West. North and South is taken three manner of wayes. One way, simply as I spake of it euen now: the other are in respect: as first for example, what soeuer is from our Zenith toward the North pole is said to be Northward, and what soeuer is from thence toward the South pole, is sayd to be Southward: and in this respect is cape Saint Vincent called the Southcape being compared with cape sinister because it is toward the South pole in respect of this. Againe North and South are taken in respect of the eclipticke, whereupon euery starre distant from the Ecliptick toward each pole is said to haue North or South latitude according to the pole toward which it bendeth: as for example, the starre called the lesser dogge in respect of the eclipticke is sayd to haue South latitude, because it leaneth from the ecliptick toward the South pole 39. d. 10. m. yet in respect of the equator it is counted Northern because it declineth from the equator toward the North pole. 5. d. 57. m.

P. I vnderstand you well: what other vse hath the equator in the terrestriall Globe.

M. You heard me speake in the vse of the celestiall globe of a right sphere, & of the diuers accidets belonging thereto, as that the day and night therein was alwayes of an equall length, and that the starres did rise & set in 12. houres: the equinoctiall line therefore in the terrestriall globe, expresseth, who they be that haue the right sphere

and

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and see the accidents belonging thereto. As those of the
the Iland Gilolo, of Celebes, of Borneo, of Taprobana,
part of Africa, and America. Moreover the degrees
of the Equator are the common scale of the terrestriall
globe whereby wee knowe what distance there is from
place to place in this manner, set the one foote of your
compassse in the one place assigned, & extend the other
foote vnto the other place: apply your compass so exten-
ded vnto the equinoctiall, the degrees intercepted be-
twene the feete of your compassse expresse the distance,
P. In deede I finde hereby how many degrees of
the equinoctiall are contayned betwene the feete of the
compassse, but how shall I expresse their distance, ether
miles or leagues?

M. You must expresse that according as the allow-
ance is of severall cosmographers. *Ptolomee* alloweth
unto euery degree of any great circle described on the
earth 500. furlōgs or 62 miles & $\frac{1}{2}$. We allow 60. miles or
3. leagues. The French man alloweth 16. leagues and $\frac{2}{3}$.
The Spaniard maketh euerie degree 17. leagues & $\frac{1}{2}$: So
that if you multiply the nūber of degrees intercepted be-
twene the feet of your compassse by any of the foresaid
multipliers the product giueth the distance of the 2 places e-
ther in miles, or leagues according to the denominatiō of
the multiplier. Another vse of the equator is this: in it the
longitude of any place is found, the latitude is counted frō it.

P. Here according to your promise, I pray you in-
struct me in these thinges, that I may know readily how
to distinguish the longitude, & latitude of the terrestriall
globe from them of the celestiaall globe.

M. That wil I do so plain as I can: the lōgitude of the
celestiaall globe beginneth at the head of Aries, in the terre-
striall

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striall Globe it beginneth in the equator at that great circle, which being drawen from the Pole of the World through the fortunate Ilandes (as *Ptolemee* will haue it) cutteth the equator at right angles. Againe the longitude celestiall is counted in the eclipticke the terrestriall longitude is counted in the equinoctiall. Thirdly, the celestiall longitude is counted from the head of Aries in the Eclipticke vnto that great circle which is drawen from the pole of the Eclipticke through the starre, or any points assigned in the heauen, vnto the eclipticke: the terrestriall longitude is counted in the equator from the foresayd great circle vnto that which is drawen from the poles of the world vnto the equator, through the Cities or any other point assigned in the terrestriall Globe. Last of all, the longitude in the celestiall Globe is found out by the quadrant of altitude applied to the poles of the eclipticke: in the terrestriall Globe it is found out by the meridian. In regard of these differences, wee define the terrestriall longitude to be the arcke of the equinoctiall contained betweene the great circle passing through the fortunate or Canary Ilandes, and the great circle drawen from the poles of the world through any point assigned in the Globe: according to the degree of that arcke so is the longitude assigned to be, as if the degrees be 20. 30. 40. &c. The place or point assigned is sayd to haue 20. 30. or 40. degrees of longitude.

P. Giue mee leaue here to moue certaine questions for myne instruction. First, why is the longitude counted in the equator, and not in the meridian from pole to pole, or in some other great circle?

M. You know it is an vsuall custome when a thing is offered to vs that is both long and broade (the dimen-

Terrestrial Globe.

sions being vnequall, to call that the length of the thing which is the greatest, and that dimension which is the shortest wee call the breadth. The Geographers therefore taking suruey of the world, & finding the inhabited part thereof to be more betweene East, and West, than between North and South, they gaue the name of longitude to that part following or accustomed manner in these dimensions.

P. In speaking of the beginning of longitude, you sayd that according to *Ptolemee*, it was to bee counted from the meridian of the Canarie or fortunate Ilandes: why did you put in those wordes?

M. There is a diuersity in the beginning of longitude among the Cosmographers, & therefore I thought good by my words to insinuat so much vnto you, *Ptolemee*, and the ancient Cosmographers began their account at the foresayd meridian. But the later men haue begun it at the meridian, which runneth through the Ilande of S. Michael, as you may see vppon the terrestrial Globe wherein this meridian is diuided into degrees, that it may be the better distinguished from the other.

P. Why did they begin at this place, and why did they account from thence Eastward?

M. *Ptolemee* began at the forenamed meridian of the Canarie, or fortunate Ilandes, because in his time they were, the furthest places of the worlde discovered toward the setting of the Sonne, & he did therefore reckon to the Eastward, because from the fortunate Ilandes to the Westward, there was not any hope of more land, but to the Eastward there was. The later age began at the meridian of Saint Michael, because vnder that meridian the compass hath no variation, but respecteth duly

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the North and South as most men affirme, though other say it hath his iust position vnder the meridian of *Cornu* and *Flores*: and others betweene the Ilandes of *Flores* and *Faiall*, which are all in the number of those Ilands that are commonly called *Acores*: They accounted also the longitude the same way that *Ptoleme* did, thinking indeede that beyond that place there was nothing but sea. But since the world hath bin found to be habitable round about: there haue bin some that haue begun the longitude at some such certaine place as liked them best, and haue counted to the Westward: as for example, the Spaniards who travelling much vnto the Westindia, haue begun their longitude at Toledo and counted it Westward.

P. What difference make you betweene a circle of longitude and the meridian: mee thinketh by your wordes they are confounded.

M. It is so, they are confounded for every circle of longitude is a meridian, & contrariwise every meridian is a circle of longitude, but they are distinguished by their office: so farre forth as the circle drawn through any place assigned limiteth the distance in the equinoctiall which the said place hath from the meridian passing through the Canarie Ilandes, or any other meridian from whence the longitude is accounted, in that respect it is called a circle of longitude. But in regard that when the sunne cometh to this circle it is then high noon or midday, it is therefore called a meridian.

P. Are there then so many circles of longitude as there be meridians?

M. Yea that there are, though vpon the globe all the circles of longitude are not expressed, as for example

Terrestrial Globe.

upon *M. Moleneux* his globe they are drawn but through each tenth degree.

P. How is the longitude of any citie or towne assigned upon the globe to be found out?

M. The instrument serving for this purpose is the meridian of the Globe, it supplyeth the want of all the circles of longitude which are not expressed: Therefore if you bring the citie assigned to the meridian of the globe the arcke of the equator contained between the said meridian, & the first meridian of longitude expresseth the longitude of the place assigned: so that the said arcke be taken and accounted according to the orderly succession of the degrees of the equator.

P. I pray you expresse the meaning by some example on the globe.

M. I will. I bring Ierusalem to the meridian, and finde betweene it and the first Meridian of longitude 72. degrees, 30. minutes of the Equator: so much I pronounce the longitude of that place to be, because the succession of the degrees of the Equator is orderly taken: againe I bring the citie of Mexice in America to the Meridian: & albeit betweene the meridian of that place and the first meridian of longitude there bee contained but 90. d, 30. m. yet must I not affirme that to be the longitude of Mexico, because counting from the first meridian to the meridia of Mexico I count against the orderly successiō of the degrees: therefore I must haue regard vnto the said successiō & pronounce Mexico to be from the first meridian 269. degrees, 30. minutes. But that you may not bee deceived in counting the longitude, let this be a generall rule, and easie vnto you: if the first meridian of longitude be on the left hand of the meridian of

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the Globe which is taken for the meridian of the place assigned, then beginne at the first meridian, the degrees of the shortest arcke of the Equator from the left hand towards the right expresse the Longitude. But if the first meridian or circle of longitude be on the right hand of the meridian of the Globe then beginning at the first meridian the degrees of the greatest arcke of the equator from the right hand to the lefte, declare the longitude of the place assigned.

P. Mee thinketh by your wordes that the longitude of euery place must be accounted continually by degrees.

M. Yea, it must be so accounted, but if it be your pleasure to know how many miles or leagues &c. it is distant from the sayd first meridian: Extend the foote of your compasses, from the place assigned to the first meridian of latitude according as you were taught before in taking the distance from place to place, and apply your Compasses afterward vnto the equinoctiall line, the degrees thereof intercepted betweene the feete of your compasses being conuerted into miles or leagues, will giue the distance.

P. You said, that if I bring the place knowen vnto the meridian I shall finde the longitude, whereupon as I thinke I may contrariwise inferre this, that if the longitude of any place knowen be brought vnto the meridian I shall be sure to finde the place vnder the meridian if it be expresse in the globe.

M. You say true, and hereby also you may learne thus much, that many places may haue one and the same longitude because many places of the terrestriall globe may be contained vnder one & the same meridian.

P. But

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P. But haue they all one longitude that are vnder the same meridian?

M. Not so, for as you see by the Globe, each circle of longitude maketh 2. seuerall interseptions with the equator the one on the one side, the other on the other side right opposite: whereupon it cometh to passe, that those places which are vnder one and the same meridian may differ 180. degrees in longitude. Those places therefore are sayd to be in one longitude which are vnder that halfe of the meridian, which is contained betweene the 2. poles from whom there cannot be imagined a right line to be drawn paralel vnto the diameter of the Equator. But if the one place lie vpon the one side of the meridian and the other place beyond the pole on the other side of the meridian, then cannot they haue the same longitude.

P. They that haue the same meridian, haue they any thing common, and what haue they differing one from another in respect of the thinges appearing in the reuolution of the heauen?

M. I cannot conueniently answere vnto this question, vntill such time as I haue instructed you in the latitude, let it rest therefore vntill then, and note this in the meane time, that as two or more places may haue one longitude, so many may differ in longitude.

P. Is it expedient for me to obserue the difference of longitude betweene place and place, then tel me how I may finde it by the Globe?

M. The longitude of the two places being seuerally sought out, as you were taught before, bring that place which hath the lesser longitude, vnto the South side of the meridian: if the other place be ether iust vn-

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der the North side of the Meridian, or on the East side thereof, subduct the lesser longitude from the greater, the remainder giueth his difference of longitude: But the place which hath the lesser longitude beeing brought to the South side of the meridian, if the place which hath the greater longitude be on the West side thereof, subduct the greater longitude from 360. degrees, adde the remainder to the lesser longitude, the total summe giueth the difference of longitude: otherwise if you be not skilful in Arithmetick, the place which hath the lesser longitude being as I told you brought vnto the meridia, the degrees of the equator cōtained between it & the longitude of the other place, afford the difference of longitude.

P. The difference of longitude being knowen, what may I inferre thereon?

M. First you may infer your course frō the one place to the other cā neuer be north & south: but vpon some other point of the compas. Secōdly they neuer haue the same hours of the day or night: for if it be noon or midnight to the one, it is past, or before noone or midnight vnto the other. yet in the opposit houres they may agree as if it be 6. in the morning it may be 6. at night to the other, if it be noone to the one, it may be midnight to the other, the difference of longitude being iust 180. degrees.

P. If they that differ in longitude do thus differ in their houres, how shall I know by the globe (comparing two places together) which of them preuenteth one the other.

M. Bring ether of the two places vnto the meridian, if the other be to the Eastwaad thereof. I say that that place which is vnder the meridian is preuented in the

time

Terrestriall Globe.

time. As if the question were betweene London and Rome, London being brought to the meridian, Rome is found on the East side thereof, therefore I say that London is preuented in the time, and that at Rome it will be 6.7. or 8. a clocke in the morning &c. before it be the same houres at London. Contrariwise if one of these places being brought to the meridian, the other be found on the West side thereof, then doth the place vnder the meridian preuent the other, as for example. London & Mexico being compared together, London being placed vnder the meridian, Mexico is on the West side thereof, therefore London preuenteth Mexico: whereby I may conclude, that it is 6. a clocke in the morning at London before it be 6. a clocke at Mexico. &c.

P. You haue taught me to know which place preuenteth the other, tell mee now how long the time is wherein the one place preuenteth the other?

M. If you conuert the difference of longitude into houres & partes of houres as is conuenient, you shal easily find out what the time is, wherein the one place preuenteth the other. Otherwise you may do it thus: bring the westermost of the two places assigned vnto the meridian, set the index of the houre circle vpon 12. a clocke, turne the globe Westward vntill the other citie come to the meridian, the Index expresseth how long the time is wherein the westermost of the two places is preuented. As for example, if the index light vpon the third houre, then doth it signify that it is but 9. a clocke at the westermost place when it is 12. a clocke at the other &c. and what eclipse or other celestiaall appearance the Westermost place seeth at 12. a clock, the other seeth it at 3. a clocke after noone &c.

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P. What haue you else to say of the equinoctiall circle?

M. It is the beginning of latitude.

P. Let me thoroughly conferre with you about this matter: how do you define latitude in respect of the terrestriall Globe?

M. It is the distance of any point assigned in the terrestriall Globe from the equator, limited by the degrees of a great circle drawn from the poles of the World through the point assigned.

P. Then by your wordes I gather this, that for so much as the beginning of latitude is in the equinoctiall, what so euer is vnder that circle, can haue no latitude. Also the latitude may be counted toward ether of the poles, so that it is ether Northerne or Southerne according as the pole is, toward which the place bendeth from the equator. But when you say that the latitude must be accounted from the equinoctiall to the place, doe you not meane the Zenith?

M. Yes, you must alwaies so vnderstand it: for albeit the word latitude be applyed to the terrestriall Globe, yet is it sought out by the circles of heauen, and commonly being demaunded what the latitude is, wee answere that it is the distance of our Zenith from the equator, notwithstanding it is sufficient speaking of the terrestriall Globe, to say that the latitude is to be accounted from the equator to the place assigned.

P. What great circle is it in which the latitude must be accounted?

M. It is that great circle of longitude which is drawn from the poles of the world through the place assigned, but because it were an infinite worke to drawe a great circle

Terrestriall Globe.

circle through euery place, therefore in seeking out the latitude wee make the meridian of the Globe to serue our turnes in this manner. Bring the place assigned to the meridian of the Globe, the degrees of the meridian intercepted betweene the equator & the place assigned, expresse the latitude of it: so I say, that the latitude of London is 51. degrees, 30. min. because London being brought vnto the meridian falleth vnderneath that degree and minute, and is so farre distant from the equator.

P. Is the latitude of London 51. degrees. 30. min? I tooke that to be the eleuation of the pole at London.

M. So it is also, for the eleuation of the pole and latitude are all one in number: for this is vsually to be seene vpon the Globe, that so far as any place is distant from the equator, so high is the pole from the horizon: Therefore when you desire to raise the pole of your globe vnto his due height, seeke out the latitude of the place assigned, according to that raise the pole aboue the horizon.

P. The greatest longitude is 360. degrees what may be the greatest latitude?

M. Nothing can be further distant from any circle then the pole, which is but 90. degrees, so that the greatest latitude is no more.

P. Be the circles of latitude expressed on the globe?

M. Yea as many circles as are parallell to the equator, may rightly be called circles of latitude, albeit some of them admit particular names.

P. Thereupon I thinke it cometh to passe that wee confound those phrases of speech to haue the same latitude, and to be in the same parallell.

M. You

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M. You say right : for a place to be in the same parallel with London, is nothing els but to be in the same latitude, & to be of equal distance with it from the equator.

P. You said before, that if I see any place what soever upon the Globe, bringing it vnto the meridian I shall find the latitude thereof. Contrariwise therefore if I know the latitude of a place and seeke it out in the meridian ether toward the North or South pole, according as the situation of the place requireth, I shall be sure to finde out the place in the reuolution of the globe, if it be inscribed in the globe.

M. That also is true: but if both the longitude, & the latitude of a place be giuen, you cannot but find it out presently in this manner. Bring the degree of longitude vnto the meridian, set the Globe fast, and in the meridian seeking out the latitude you shall be sure to finde the place, or at leastwise where it should be, if it be expressed in the globe. Thus much concerning the longitude and latitude.

P. Then must I trouble you with a question propounded before, which was this, what thing they haue in common, and wherein they may differ that haue one longitude: the which question you promised to satisfie me in, when you had discoursed of the latitude.

M. I will doe what I can, especially because I know it is most pleasant. You see by the Globe that of the vnerall inhabitants of the Earth dwelling ether on the North or South side of the equator. Some may haue diuers longitudes, but the same latitude, as the Germans, the Muscouites, the Tattariás &c. differing in longitude haue notwithstanding the same latitude with the Englishmen, These inhabitants generally considered are called

Terrestriall Globe.

Perieci : they haue their Zenith in the same parallell: the
starres rise and set vnto them all vpon the same point of
the compasse, and at the same houre, and haue the same
height aboue the horizon. They haue the day and night
increasing and decreasing alike vnto them all: & the sea-
sons of the yeare changing after one manner and at one
time, yet they that dwell to the Eastward of the other
preuent the other dwelling to the westward in the time:
as thus, they in Germanie may see the Sunne rise at fixe
a clocke, so may we in England, yet their 6. a clocke pre-
uenteth ours by an houre more or lesse, according as
they are more or lesse vnto the Eastward, so that when
the sunne riseth vnto them at fixe a clocke, it is then
but fise a clocke to vs that dwell fiftene degrees more
vnto the Westwarde, and the Sunne will haue beene
vp vnto them an houre, when hee beginneth but new-
ly to rise vnto vs. And if wee happen to see the moone
eclipsed at nine a clocke they that dwell forty fise de-
grees from vs Eastward, shall see her eclipsed at twelue
a clocke, yet shall it be but fixe a clocke to them that
dwel as many degrees frō vs to the westward. Here you
are to vnderstand this, that albeit the word Perieci ac-
cording to the signification thereof, may bee generally
applied to all them that haue the same latitude, yet pro-
perly in Geographie, it is attributed vnto them that haue
the same meridian, but dwel on the contrary sides there-
of, and haue their difference of longitude 180. degrees
and one of the poles of the world alwaies in the mid-
dest betweene their verticall pointes, such are they
that dwell in Arabia, Felix on the one side, and in
Hispania noua on the other side of the meridian.
These men differ one from another in this, that when

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it is high noon to the one, it is midnight to the other, and contrariwise: item when the Sunne setteth to the one, he riseth to the other, and contrariwise: item the South side of our meridian is their North side: all these communities and differences may be easily found out vpon the Globe ether by applying a thredde vnto the Globe in stead of another Horizon, or else by comparing the two globes together: The thredde must crosse the meridian so many degrees distant from the pole as the pole is distant from the horizon: as if the pole of the place assigned be 50. degrees, the thredde must crosse the meridian in the 50. degree on this side the pole. From the meridian, it must bee directed to the East point of the Horizon, and from thence crossing the nether side of the meridian in the 50. degree from the pole, it must be directed to the West side of the horizon vntil it come to the vpper side of the meridian againe. So shal you most easily perceauce all those communities, and differences of the Perieci to be true, whereof I spake before: that their dayes and nightes being seuerally compared are of an equall length: that the starres and the Sunne rise and set at the same houres &c.

P. If I were desirous to trye this by two seuerall globes how shall I goe to worke?

M. You may goe to worke diuers wayes, as you thinke best for your owne capacity: hauing raised the poles of each globe according to one and the same elevation: set the Globes so one by the other, that the East point of the one may ioyne with the West point of the other, or that the South pointes of their horizon may close and ioyne directlie all together, or which you take to be better their Northren pointes. Set also the

Zenith

Terrestrial Globe

zeniths in their places according as the elevation of the pole doth direct you. Here must you conceave this, that the greater arcke of the meridian is the noonetide line and the lesser arcke from the pole downward to the Horizon, and vnder it is the line of midnight: then seeke out the place of the Sunne for any day propounded, and bring it to the East side of the one globe, and to the West side of the other (for of them that are peculiarly called *Periect*, the one seeth the sunne and starres setting, when the other seeth them rising) afterwarde turne the Globes so about, the one from you, the other toward you in such sort, that the place of the Sun rising to the one may fall vnder the horizon of the other, for by that meanes you shall finde out the communities and differences spoken of before.

P. I doe partly perceave the matter I hope by practise to vnderstand it the better. Proceede now I pray you in that, which I requested at your handes.

M. As some of those which inhabit ether the North or South part of the earth may haue the same latitude, but diuers longitudes: so agayne some may haue the same longitude but diuers latitudes, as they here in England haue the same longitude, and are vnder the same meridian which the Spaniards, and those that dwell to the West side of Africa, yet do they all differ in longitudes: these men haue the selfe same houres of the day and night, with the foure seasons of the yeare. But in many other thinges they differ as they dwell nearer or further from the pole, or nearer or further from the equator. They that dwell nearer the equator haue the Sunne alwaies higher aboue their Horizon than the other that dwell further of: also they which dwell nearer to the equator

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quator haue a longer day in Winter, but a shorter night than they which dwell toward the pole: but in Sommer they which dwell toward the pole haue a longer day, & a shorter night than they that dwell toward the equator: as for example, in Winter the Spaniards day is longer than ours, namely whilest the Sunne is in the Southerne signes from the 13. of September to the 11. of March: but from the eleuenth of March to the 13. of September our day is alwaies longer than theirs. Againe from the 13. of September to the eleuenth of March their night is shorter than ours, but from the 11. of March to the 13. of September our night is shorter than theirs. Moreover the Sunne neuer riseth vnto these men at one houre, except he bee in the equator: as for example to vs and the Spaniards. Whilest the Sunne is in the North signes he riseth more early and shineth longer to vs, than to them, but the Sunne being in the South signes, he riseth more early and shineth longer to them than to vs: Last of all the Sunne neuer riseth or setteth to them and vs on the same point of the compasse. &c. all which thinges you may easily perceauo to be true by those rules which you haue heard before in the celestiall globe: if you do but find out by the terrestriall globe their seuerall latitudes that dwell vnder the same meridian, and then raise the pole seuerally, working the conclusions aforesaid according as you haue bin taught.

P. Haue not these people any peculier name which dwell vnder one meridian, but differ in latitude?

M. No, but there are another kinde of people hauing one longitude which haue a peculier name, and are called Anteci. They are such inhabitants of the earth as dwell vnder one meridian, and haue the same longi-

gude

Terrestriall Globe.

ude, & also the same latitude, but toward diuers poles:
so that as farre as the one dwelleth from the equator
northward, the others haue the same distance from it
Southward, and as high as the North pole is raised to
the one, so high is the South Pole raised to the o-
ther. Such are they that dwell in the West side of Ara-
bia twentie degrees Northward, and they that dwel in
Madagascar in the same longitude twentie degrees to
the Southwarde. These men haue the day and night
of equall length, the Sunne rising and setting at the
same houres on the same point of the compasse, but
at diuers times and the seasons of the yeare are oppo-
site: as when it is Sommer to them which dwell in A-
rabia, it is Winter to them in Madagascar. And con-
trariwise, when the day is longest to them in Arabia, it
is shortest to them in Madagascar. Furthermore, if the
Sunne rise 25 degrees from the East to them in Arabia,
hee riseth so many degrees from the East to them in
Madagascar, but to the one in Sommer, to the other in
winter if the day be fourteene houres long to them in A-
rabia it is so long also to them in Madagascar, but hee
possesseth contrary signes. These thinges may seuerally
be tried by the globe, or by comparing your 2. Globes
together, and raising the North pole of the one, and
the South pole of the other aboue the Horizon, so
shall you see that that degree of the Eclipticke which
continueth longest aboue the horizon to them that dwell
Northward, continueth the shortest aboue their Ho-
rizon to that dwel Southward. Moreouer also you may per-
ceiue this, that they which dwell Northward see the
Sunne rising, and the Heauens moouing from the left
and to the right, but they which are to the Southward

see

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See the Sunne arising, and the heauens moouing from the right hand to the left. Besides these inhabitants before named there are other to be noted, which because they goe foot to foote right opposite one to the other, they are therefore called of the Grecians *Antipodes*, and *Antichthones*, because they dwell in opposite places of the earth.

P. Mee thinketh it is impossible that you speake how can they that are vnder vs walke vpon the earth without falling. Can two men walke the one on the top of a wheele, the other on the nether side thereof without tumbling downe?

M. Your reason is not alike in the wheele and the earth. All they that dwell vpon the earth haue one common centre in the Globe of the earth, vnto which they doe naturally tend in respect of their grauity, and therefore where soeuer they stand they cannot fall from the earth, but bend naturally vnto the centre thereof. But they which stand vpon a wheele, or any such round thinge els haue not any one point in the wheele, or the round bodie, vnto the which they doe naturally bend, and therefore whensoever he cometh vnto any such place of the wheele, wherein his legs cannot keep the weightines of his bodie perpēdicular and imminent to the centre of the Wheele, he must needes fall from the wheele toward that centre, vnto which naturally he inclineth, which is the centre of the earth. This is certain both by reason and experience of our owne countrey, that there are *Antipodes*, and therefore let the truth preuaile with vs more than the opinions either of *Augustine* or *Lactantius*, who haue stoutly denied the *Antipodes*, yea *Lactantius* (as I remember) held it here

Terrestrial Globe.

heresie, and counted them accursed that sayd there were
antipodes.

P. How doe you define the Antipodes?

M. They are certaine inhabitants of the earth right
opposite one to another in the extremities of the diame-
ter of the Globe. Therefore the antipodes haue the same
meridian, yet they differ in longitude one from the other
80 degrees. They haue the same horizon indeede, but
differing in reason, namely thus, that the Zenith or ver-
tecal point of the one is the nadir to the horizon of the
other: and contrariwise, they haue also the same latitude,
but bending toward contrarie poles.

P. How shall I readily by the globe finde out who
are antipodes one to another?

M. Bring any point or place assigned in the globe
into the meridian, and note what latitude it hath, the
point or places hauing the selfe same latitude in the me-
ridian vnder the Horizon is the habitation of them, that
are antipodes to the former. Such are the inhabitants of
Trinideda and Iaua maior, also the inhabitantes of old,
and new Guinea, with infinit other places of the earth,
whose antipodes are not yet discouereed. The Antipo-
des haue all thinges contrary (excepting those that dwell
vnder the equinoctiall) if the heauen moue to the one
from the left hand to the right it moueth contrary waies
to the other, if it be day to the one it is night to the
other, if the Sunne rise to the one he setteth to the other,
if the day or night increase to the one, it decreaseth to
the other, if it be Sommer to the one, it is Winter to
the other &c.

P. Why do you make exception of those that dwell
vnder the equator.

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see the Sunne arising, and the heauens moouing from the right hand to the left. Besides these inhabitants before named there are other to be noted, which because they goe foot to foote right opposite one to the other, they are therefore called of the Grecians *Antipodes*, and *Antichthones*, because they dwell in opposite places of the earth.

P. Mee thinketh it is impossible that you speake of how can they that are vnder vs walke vpon the earth without falling. Can two men walke the one on the top of a wheele, the other on the nether side thereof without tumbling downe?

M. Your reason is not alike in the wheele and the earth. All they that dwell vpon the earth haue one common centre in the Globe of the earth, vnto which they doe naturally tend in respect of their grauity, and therefore where soeuer they stand they cannot fall from the earth, but bend naturally vnto the centre thereof. But they which stand vpon a wheele, or any such round thinge els haue not any one point in the wheele, or in the round bodie, vnto the which they doe naturally bend, and therefore whensoever he commeth vnto any such place of the wheele, wherein his legs cannot keep the weightines of his bodie perpendiculer and imminent to the centre of the Wheele, he must needes fall from the wheele toward that centre, vnto which naturally he inclineth, which is the centre of the earth. This is certain both by reason and experience of our owne countrey, that there are *Antipodes*, and therefore let the truth preuaile with vs more than the opinions either of *Augustine* or *Lactantius*, who haue stoutly denied the *Antipodes*, yea *Lactantius* (as I remember) held it

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heresie, and counted them accursed that sayd there were antipodes.

P. How doe you define the Antipodes?

M. They are certaine inhabitants of the earth right opposite one to another in the extremities of the diameter of the Globe. Therefore the antipodes haue the same meridian, yet they differ in longitude one from the other 180 degrees. They haue the same horizon indeede, but differing in reason, namely thus, that the Zenith or vertical point of the one is the nadir to the horizon of the other: and contrariwise, they haue also the same latitude, but bending toward contrarie poles.

P. How shall I readily by the globe finde out who be antipodes one to another?

M. Bring any point or place assigned in the globe into the meridian, and note what latitude it hath, the point or places hauing the selfe same latitude in the meridian vnder the Horizon is the habitation of them, that be antipodes to the former. Such are the inhabitants of Trinideda and Iaua maior, also the inhabitantes of old, and new Guinea, with infinit other places of the earth, whose antipodes are not yet discouereed. The Antipodes haue all thinges contrary (excepting those that dwell vnder the equinoctiall) if the heauen moue to the one from the left hand to the right it moueth contrary waies unto the other, if it be day to the one it is night to the other, if the Sunne rise to the one he setteth to the other, if the day or night increase to the one, it decreaseth to the other, if it be Sommer to the one, it is Winter to the other &c.

P. Why do you make exception of those that dwell vnder the equator.

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M. Because they being aswell Perieci, as antipodes haue all the seasons of the yeare agreeable, and the same length of day & night, & the Sun rising & setting at the same houre, yet when he riseth to the one, he setteth to the other, & the houres of day and night are opposite, for when it is high noone to the one, it is midnight to the other: when it is 11. a clocke in the morning to the one, it is 11. a clocke at night to the other &c. Thus briefly cōcerning the cōmunities & differences incident to sundry inhabitantes of the earth in regard of their difference and agreement ether in longitude or latitude. Let vs now speake of the meridian.

P. Me thinketh that it hath the same vse in diuiding the terrestriall, which it hath in diuiding the celestiall Globe into two seuerall partes, whereof the one is the East, the other the West: So that what people or countries soeuer are toward the East side from the meridian of any place may be called the Easterne people, and the other toward the setting of the Sunne may be called the Westerne people.

M. It is true that they may bee so called, but it is respectiuely, onely in regard of the place wherein you dwell, otherwise the true East and west parts of the terrestriall Globe are limited by the first meridian, or circle of longitude: what countries soeuer lie from that meridian Eastward an hundred and eightie degrees are called the East countries, and the other are called the West: yea the names of these places by meanes of the first inuentors of Geographie are knowen so authentically, that they are not chaunged as the other be, which only are spoken respectiuely, for albeit it so fall out (as many times it doth in traouailing farre) that Hispaniola

Terrestriall Globe.

or Cuba, Brasill, and all that coast of America do lie from vs to the Eastwarde, yet doe wee commonly call them the West India. Agayne though that Sumatra, Borneo, the Moluccas, and diuers other places also thereabouts bee from vs towards the setting of the Sun, yet doe wee tearme and call them by the name of East India.

P. What are the partitions in the meridian?

M. Those which are next vnto the Globe are the degrees, which haue no other vse thā hath bin spokē of, either in the celestial globe, or heretofore in the terrestriall, when I spake of finding the latitude of any place. But besides the degrees, there are other partitions seruing particularly vnto the terrestriall Globe. Those partitions which are next about the degrees expresse the quantitie of the longest day, so that when you shall heare the day to be 13. 15. 24. houres long, or 1. 2. 3. moneths long &c. You may by these partitions finde out what people they are which haue the day of such a length. The vpper most partitions are the climates.

P. What is that which you call a climate?

M. It is nothing but a certaine space of the earth contained betweene two imaginarie circles parallell to the Equator: From the beginning of which space to the ende the longest Daye admitteth the difference of halfe an houre. As for example, the space of the terrestriall globe betweene the 12. d. 45. min. of latitude where the longest day is 12. houres and three quarters, to the latitude of 20. d. 30. m. where the longest day is 12. houres $\frac{1}{4}$ is called a climate.

P. How many climates are there?

M. The number of the climats are diuers. The anciēt

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Cosmographers made but 7. beginning at the 12. d. 45. m. of latitude, and ending at the 50. d. 30. m. But they which succeded, added two other, and made 9. climates the which number is expresse vpon the meridian of the Globe. Others made 19. neglecting the ordinarie increase of halfe an houre in the longest day, and the place also where the ancient Cosmographers began their climates. Others made 23. others 47.

P. Why did the ancient Cosmographers begin at the 12. degree 45. minutes of latitude, & end at the 50. d. 30. m.

M. They thought that that part of the earth betwene those two paralleles to bee habitable, & therefore had onely respect to them. But the latter Cosmographers knowing the earth to be more habitable, extended their climates over the whole surface thereof from the equator to the pole.

P. Methinketh the Climates on the meridian, extended but toward one pole, are they not also to be considered toward the other pole.

M. Yes, in the selfe same distance from the equator, but with contrarie names.

P. Hath each climate, a feuerall name?

M. Yea, for they are denominated according to the name of certaine notable places, which are in the middle of them, as appeareth in the Table following: the Climates to the Southward are called by the same name, the word anti (which signifieth against) being put therunto: as for example, that which is the next beyond the equator to the Southward is called anti dia Meroes, because it is as farre beyonde the Equator as that Climate which passeth through Meroe is on this side thereof, &c.

to the ancient Cosmographers.

The number & limits of the Climates.	Hours.Min.	Height of the pole,	The breadth in miles,	The names.
Climate 1. { The beginning The middest The end	12 13 13	45 0 15	12 d. 45 m. { 484 16 d. 40 m. { 20 d. 30 m. { 465.	Through Meroe.
2 { The beginning The middest The end.	13 13 13	15 30 45	20 d. 30 m. { 437 24 d. 15 m. { 27 d. 30 m. { 420.	Through Syene.
3 { The beginning The middest The end.	13 14 14	45 00 15	27 d. 30 m. { 385 30 d. 45 m. { 33 d. 40 m. { 370.	Through Alexandria.
4 { The beginning The middest The end	14 14 14	15 30 45	33 d. 40 m. { 333 36 d. 24 m. { 39 d. 00 m. { 320.	Through Rhodes.
5 { The beginning The middest The end	14 15 15	45 00 15	39 d. 00 m. { 281 41 d. 20 m. { 43 d. 30 m. { 270.	Through Rome.
6 { The beginning The middest The end.	15 15 15	15 30 45	43 d. 30 m. { 234 45 d. 24 m. { 47 d. 15 m. { 225.	Through Boristhenes.
7 { The beginning The middest The end	15 16 16	45 00 15	47 d. 15 m. { 203 48 d. 40 m. { 50 d. 30 m. { 195.	Through the Rhiphaean mountains.

Unto the which these are added by the latter Cosmographers.

8 { The beginning The middest The end.	16 16 16	15 30 45	50 d. 30 m. { 173 51 d. 58 m. { 53 d. 17 m. { 167.	Through Meous.
9 { The beginning The middest The end.	16 17 17	45 00 15	53 d. 17 m. { 142 54 d. 29 m. { 55 d. 34 m. { 137.	Through Denmark.

Terrestriall Globe

Loe here is the Table of the ancient Cosmographers, wherein is expressed the number of the Climates with their limites, &c. as you see it set downe in the front thereof.

(g)

By this Table, as also by the Globe you may gather (*Philomathes*) the whole difference of time from the beginning of the first climate to the last to be 4. houres and an halfe : but the diuersitie of the height of the pole is 42.d.49.m the breadth of them according to *Ptole-mee* is 2359.miles $\frac{3}{8}$: but according to our account, that ascribe to euery degree of a great circle 60 miles, it amounteth vnto 2569. miles. The other thinges which may be sayd concerning the Climates, as that the beginning of the one climate is the end of the other, and that the climates next vnto the equator are greater than those which are further of &c. I leaue them to your owne contemplacion because you may gather them not onely out of this table, but also out of the globe it selfe. Yet this I must tell you that the Cosmographers haue diuided each climate into two partes, whereof each part is called a parallell. So that in this sence a parallell may be defined briefly to be the limite of halfe a Climate or otherwise, it is a portion of the terrestriall Globe contained betweene two circles from the beginning whereof vnto the end the longest day admitteth the difference of a quarter of an houre. But of this matter let this suffice. Let vs now speake of the eclipticke.

P. With a good will, to what ende serueth that circle, mee thinketh it should be needles in this globe.

M. No, for hereby the terrestriall Globe is not only made fit to serue for all those propositions, which

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in the Celestiall globe are performed by knowing the place of the Sunne, but hereby also wee learne whether the Sun passeth by the Zenith of any people yea or no, & what people they be by whose Zenith he passeth not, and how many times hee passeth by them, and how far he is distant from their Zenith, with other conclusions more, whereof I will speake hereafter, as they come to my memory.

P. How shall I know whether the Sunne passeth by the Zenith of any place yea or no?

M. You know, that the Eclipticke expresseth the high way of the Sunne: therefore as many as dwel within the obliquitie thereof betweene tropicke and tropicke must needes see the Sunne in their Zenith, the rest from ether tropick to each pole neuer haue the Sunne in their Zenith.

P. How often may the Sunne bee in the Zenith.

M. Not aboue twise to any nation, and to some but once. As many as haue their latitude equall to the greatest declination of the Sunne, they neuer see the Sun in their Zenith but once, such are all they that dwell in vnder the tropickes. But as many as dwell within the two tropickes haue the Sunne perpendicular ouer their heads twise in the yeare, namely at that time, when the declination of the Sunne, and the latitude of the place are equall one to the other, for then the Sunne declining from the equator commeth to their Zenith, and passeth beyonde it to the tropicke, and descending from the tropicke hee crosseth their verticall point againe.

P. Then in seeking out the declination of the Sun, & the latitude of any place, I shall not only know whe

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whether the Sunne commeth to the Zenith of the said place,
but also at what time he commeth thether.

M. You say well, for if the declination of the sunne,
& the latitude of the place ether are, or may be equall,
then wil the Sun passe by the Zenith, but if the latitude
be greater than the declination of the Sunne may be,
the Sunne neuer commeth to the Zenith. Againe when
the Sunne possesseth any degree of the eclipticke having
a declination equall vnto the latitude of the place assign-
ed, that day will he crosse the verticall point of the said
place.

P. If the Sun be not in the Zenith, how shall I know
his distance from it by the Globe?

M. Seeke out in the meridian the declination of the
Sunne, and there make a marke, seke out also the la-
titude of the place assigned, there also make a marke,
the degrees of the meridian intercepted betweene the
two markes expresse the distance of the Sunne from the
Zenith: So shall you finde the Sunne in Cancer to be
distant from our Zenith here at London 28. degrees, but
being in Capricorne, hee is distant from it 75. degrees.
If you desire to know this by rule, the rule is: the place
assigned being without the Tropickes, and the Sunne
declining toward the pole eleuated, the declination of
the Sunne taken frō the latitude geueth his distance frō
the Zenith, as the Sunne declining Northward twenty
degrees, twelue minutes, is distant from our Zenith at
London thirtie degrees, eightene minutes. If the Sun
decline from the pole eleuated, his declination added
to the latitude, giueth his elongation from the Zenith.
Item, if his place assigned bee within the two Tro-
picks, his declination toward the pole eleuated, cōpared

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with his latitude, and the lesser being subducted from the greater, the remainder geueth his distance from the Zenith: Otherwise if the Sunne decline from the pole eleuated, the totall summe made of the declination, and the latitude affordeth the foresayd distance. If the place assigned be vnder the equator the declination of the Sun is equal to his distance from the Zenith according as you may perceauce by the Globe.

P. What other vse hath the eclipticke in the terrestriall Globe.

M. We are hereby certified of the seuerall seasons of the yeare in each seuerall place. Summer is caused by the accessse of the Sun vnto our Zenith: Winter, by his recessse from the same. Hereby therefore wee may gather what people haue two winters and two Summers: also who haue but one winter and one Summer: as many as dwell vnder the tropicks, and from thence toward the poles haue but one, because the Sunne falleth from their Zenith, & commeth toward them but once in a yeare, they which dwell within the tropicke haue two, because the Sunne crosseth their Zenith twise, and falleth twise also from it, once to the North, and agayne to the Southward. But betweene their Summers and Winters there is not an equall distance vnto any of them, those onely excepted which liue vnder the equator: who being iust in the midst of the Sunnes proper motion haue the seuerall seasons of their yeare distinguished equally in common sence. The other haue their seasons diuided vnequally, as they that dwell in the 20. d. 12. m. to the Northward haue from their first Summer to the second two moneths, but from the second to the first Summer following in the next yeare, they haue ten moneths

Terrestrial Globe.

neths, namely all that time, wherein the Sunne is going from Leo to Gemini: Furthermore this is generally to be noted by the eclipticke, that they which dwell on severall sides of the equator haue neuer the same seasons falling out at the same time: for if it be Winter to them that dwell to the Northward of the line, it is Summer to them that dwell to the Southward, and contrariwise.

P. But they that dwell on one and the same side of the Equator haue their Summer and Winter at one time.

M. Not so, as many as are vnder or without the tropick toward the pole haue their Winter and Summer at one time, namely, when the Sunne entreth the hed of Cancer, but they that dwell from the equator to the tropicke haue their Winter and Summer onely then, when the Sunne is furthest from their Zenith, or els crosseth it. As they that doe dwell vnder the equator haue their Summers when the Sunne entreth into Aries and Libra, and then crosseth their Zenith. But their Winters fall out when he cometh to the tropicall points, and is furthest distant from their Zenith: they that dwell 11, d, 30, m. to the Northward of the line, haue their Summers when the Sunne entreth into Taurus & Virgo, but their Winters are in his entrance into the tropickes, for that is generall to them that dwell within the tropickes, that howeuer their Summers alter their times, their Winters alwaies keepe their appointed dayes, which are those, wherein the Sunne entreth the tropicall pointes.

P. Shall wee now proceede vnto the other circles of the Globe.

M. Not yet, there is one thing remaining to be noted in the terrestriall globe concerning the shadowes, that

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that are made vpon earth at noone wherevpon the inhabitants receaue diuers names, for some of them are called Ascij, others Amphiscij, others Heteroscij, & others Periscij. They are called Ascij who hauing the Sun in their vertical point do wāt the shadow of any thing that standeth vpright vpon the ground, for the Sun beame falling perpendicular vpon the earth doth illuminate the thing, which stādeth vpright round about, so that the shadow thereof cannot be seene vntill the Sun declineth frō the Zenith, Such are all they that dwel ether under or within the tropickes, as by experience you may proue vpon the terrestriall Globe by the sphericall gnomon.

P. In what manner I pray you?

M. Rectify your globe perfectly in the open aire, where the Sunne doth shine, and set your sphericall gnomon ether vpon the degree of the eclipticke, which the Sun doth possesse, or vpon any place of the globe hauing a latitude answerable to the declination of that degree which the Sun doth possesse, then turn the globe toward the Sun, & the gnomō being right against him will cast no shadow, or otherwise bring the gnomon close to the meridian, and there set it fast vntill noone, for then the Sun will fall so iust vpon the point of the gnomon that it will yeeld no shadow.

P. What are they whom you call Amphiscij.

M. They are such as haue a shadow falling two severall wayes, one while to the Northward, and another while to the Southward. These dwell within the two tropickes, as you may perceave by the terrestriall globe. This you know standeth with reason, & common sense, proueth it true, that the shadow bendeth to the opposite place from the Sunne, as if the Sunne be Southward

Terreſtriall Globe.

the ſhadow runneth Northward, whereupon this muſt needs follow, that for ſo much as they which dwel within the tropicks haue the Sunne ſometimes to the northward of their Zenith(as thoſe in the Iland of S. Thomas) & ſometimes to the Southward, they muſt of neceſſity haue the ſhadow bēding to the ſame places, as when the ſun is in the north ſignes, the ſhadow of any thing ſtanding vpright vpon the horizō muſt at noone run Southward, & when he is in the ſouth ſignes the ſhadow will bend northward. You may trie, if you wil abide the trial of it, by the ſpherical gnomō: rectify your globe, place the gnomō vpon the Iland of S. Thomas, or vpo any degree of the equator, or any other degree of the ecliptick, bring the gnomō to the meridiā whē the ſun approacheth neer vnto that degree, & mark which way the ſhadow falleth & after the ſun is paſt that degree ether aſcending or deſcending do the like againe, and you ſhall finde the ſhadow of the gnomō to fall toward a cōtrary place to that, toward which it fel before: the Hetroſcij are thoſe whoſe noonſtid ſhadow falleth but one way onely: ſuch are all they that dwel between the tropickes & the circle arcticke or antarcticke: they that dwel betweene the tropick of cācer, & the circle arcticke neuer ſee their noonſtid ſhadow bēding but to the northward becauſe the ſunne is alwaies ſouth vnto thē: contrariwiſe they which dwel to the ſouth between the tropick of capricorn, & the circle antarcticke neuer ſee the noonſtid ſhadow, but bending ſouthward. You may trye this alſo by the globe, for the globe being rectified, & the gnomō applied to any place betweene the foreſayd circles, and then brought vnto the meridian, & there ſet faſt, you ſhall not at any time finde the Sunne to caſt the ſhadow any way but one.

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The last of these are the *Periscii* whose shadow runneth round about them to every point of their Horizon in one and the same day, wherein they differ from the *Amphiscii*: For albeit their shadow being also vnto all partes of their Horizon, yet vpon one and the same day it tendeth but toward one halfe of the Horizon that is ether to the Northward or to the Southward. But the *Periscii* haue their shadowe going round about in one day. Such are they that dwell within or vnder the circles *Arcticke* or *Antarcticke*: The reason wherof is the long continuance of the Sunne aboue the horizon, who neuer setteth sometimes vntill he haue compassed the horizon round about. Now let vs come vnto the Horizon.

P. Is there nothing then to bee sayd of the two colures?

M. No, for they haue no vse but this, that the degrees of longitude beginne at that place where the equinoctiall colure and the hed of Aries concur in the Equator, so that it may in that respect bee counted the first meridian or first circle of Longitude.

P. Well then, let vs discourse of the horizon: what vse hath it in the terrestrial globe?

M. It seuereth the antipodes one from another, how soeuer the globe is situated, and is common to them both. And whereas in the Celestiall Globe you were taught to finde the length of the artificiall day, with the time of the Sunnes rising and setting: vppon the terrestrial Globe you may readily see who they be that haue the day of such a length, and the Sunne rising and setting at such a time.

P. Howe is that to bee found out, I pray you

Terrestriall Globe.

rub my memorie but with one example.

M. The length of any day being propounded seek which degree of the eclipticke the Sunne possesseth, that present day, as for example, the day being 16. houres long, I suppose the Sunne to bee in the head of Cancer: then in the first meridian or circle of longitude which is distinguished into degrees count his declination, and at the end thereof make a pricke, which in this example falleth out to be in the very interfection of the tropicke, and the foresayd circle of longitude: thirdly diuide the length of the day into two equall partes, and conuert the houres into degrees of the Equator, which as this example requireth are 120. from the head of Aries toward your right hand count so many degrees in the equator: applye the end of that number close to the meridian, raise or let fall the pole of the Globe vntil the mark of the declination made in the circle of longitude, doe touch the Horizon: the cities or other places of the terrestriall globe which are then 90. degrees distant from the Horizon in the reuolution of the globe are those, which haue the day of such a length: or otherwise, as many as haue their latitude correspondent to the eleuation of the pole are those, whose day is so long as it was propounded to be.

P. I remember now very well, that you taught mee the like of this in that proposition of the celestiall globe, wherein I learned the length of the day being giuen to finde the height of the pole.

M. You say true: this is the onely difference, that here wee must haue an eie to the latitude, because the true place of any citie or towne vppon the terrestriall Globe is found rather by it than by the eleuation of the pole

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pole, albeit in number they be all one. By that which taught you euen now, this also may be gathered, that if the Sunne being in any certayne signe assigned do rise an houre two or three ether sooner or later vnto others, than vnto mee, I say I may know what people they are as for example, if the sunne in Cancer rise vnto me at 4. a clocke, and to another at 3. or 2. a clocke in the morning or to another at 5. a clocke: how farre do they differ in latitude from me ether to the northward or to the southward.

P. I pray you tell mee, how this may bee dispatched readily.

M. The chiefest consideration, which is to bee had in this matter is in what halfe of the Zodiacke the sunne is. If the sunne be in the northren signes, they which haue the longer day haue the pole higher eleuated, than they which haue a shorter, but the sun possessing the southern signes, they which haue the longest day haue a lesser latitude, if you remember this you cannot erre, so that the situation of the places be both toward one pole, or one of them vnder the equator.

P. Let me try if I my selfe can hammer out this question: the Sunne in Cancer riseth to me at London at 4. a clocke and 45. minutes in the morning how far do they dwell from me ether Northward or Southward, that is to say otherwise, how do they differ in latitude from me, to whom being in the same signe he riseth at 3. a clocke 45. minutes. First I conclude this, that they dwell to the Northward, because their day is longer, the Sunne possessing the Northren signes: then doe I raise the pole according as the latitude of London doth require, and afterwarde bring the intersection of the first circle of
longi-

Terrestriall Globe.

longitude, and the tropicke vnto the Horizon, setting fast the Globe that it sturre not, and noting what degree of the Equator is vnder the meridian, doe consider moreouer how much their day is longer than ours: in this example it is longer by an houre conuert that time into degrees, and count from that degree of the Equator, which is vnder the meridian to the Westwarde (where as otherwise if their day had begun after ours I should haue counted them to the Eastwarde, that is, I should haue subducted them) I turne that degree to the Meridian, and afterwards raise the pole of the Globe vntill the foresaid intersection of the tropicke and the circle of longitude, doe touch the Horizon, for then is the pole at his due height, from whence if I subduct the latitude of London, I shall finde them to be the Northward of vs 5. degrees.

M. You haue concluded well: and in like manner may you finde, how farre another is to the Southward, and which of the two poles is rayfed aboue the ground: but I leaue these things to your hammering, seeing you can hammer them out so well. Let vs now all in hand with those things which are inscribed in the horizon.

P. I had thought that you had sufficiently discoursed of them in the celestiall globe.

M. Yet there is in regard of the terrestriall globe peculiar vse of the pointes of the compasse, or windes we commonly terme them. For by them may wee know how one coast or countrey beareth from another, which way it lieth, ether East, West, North, or South, or otherwise.

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P. I imagined that thing to be knowen by the crooked lines described vpon the terrestriall Globe, which you called the Rhombes.

M. Not so, indeede they teach vs how to direct our course to any place : but they teach vs not how one place lyeth from another : and therefore the Latines in this case vse 2. seuerall words, whereof the one is *Plaga* a coast, the other *directio*, a direction. Whereof the one greatly and alwayes differeth from the other, except the two places assigned, whose coast or direction I seeke for lie vnder the same meridian, or neare the equator.

P. This seemeth to be a Paradox vnto me, must I not direct my course vnto a place according as it lyeth from me?

M. No, except the places lie North, and South: for a place may be East or West from you, as the Ilandes Maldinar, which lie Easte from London, yet if you direct your course by the East, or West point of the compass, you shall neuer come there.

P. What doe you call a coast?

M. A coast is an Arke of the horizon contained betwene two verticall circles, whereof the one is alwayes the meridian, and the other is the circle, which passeth from our Zenith through the place whose position from vs wee seeke for. This arcke and position of the place vsually is denominated according to the point of the compass, vpon which the verticall circle lighteth in the Horizon: as for example, if the verticall circle light vpon the Northeast point of the Horizon, I pronounce the place to lie Northeast from me.

P. By what meanes shall I finde vpon the terrestriall globe, how any Citie doth lie from mee, and toward

Terrestriall Globe.

what coast.

M. First rectify your globe according as the latitude of your place doth require wherein you are, then fasten the quadrant of altitude to the Zenith, and bring the known place vnto the meridian, turne the quadrant of altitude to the citie, or towne assigned, whose coasting from you, you desire to know, and marke vpon what point of the compasse it lighteth in the Horizon: for according thereunto you must pronounce the place to lie from you, northeast or Southeast, or otherwise as it falleth out.

P. Is there any other vse of these points of the compasse described vpon the Horizon of the globe.

M. Yea, for being at Sea the latitude being giuen, & the point of the compasse whereupon anie known land descried doth beare from you, you shall know how farre you are from it: In this manner: rayse the pole of your globe according to the latitude, bring the quadrant of altitude to the Zenith, and then turne it to the point of the compasse vpon which the land descried doth beare from you, bring the said point of the land close vnto the quadrant, and see how manie degrees of the quadrant are contained betweene it, and your Zenith, those degrees conuerted into miles or leagues (as you were taught before) do yeld the distance. Here also note this that as you do in one so you may do in two or more heades if you descric them being at sea. Thus much concerning the vse of the greater circles of the terrestriall globe, it remaineth now to speake of the lesser: but for much as this matter whereof I haue now last of all instructed hath great affinitie with the Rhombes, if it please me I wil instruct you in them, and their vse before I fall

in hand with the lesser circles.

P. I pray you doe so, and for so much as I could neuer see any Author which did write of them, give me leaue to require what I doubt of them and their vse?

M. With a good will, I will doe what I can to satisfy you.

P. What is the reason of this name, & why are they called Rhombes?

M. We in our speech call the the points of the compasse: but the name of Rhombe is receaued from the Spaniard the reason of the name is this, as I gather it. Among the geometricians as you know this kind of figure

 is called a Rhombe: for so much therefore as the pointes of the compasse described vpon the globe, but especially in the plaine sea card, do represent such a like forme, hereupon the Spaniard hath giuen this name vnto these lines, translating the name from the plaine Sea card to the Globe. And here I may craue leaue of you to vse this name, because I find it teaching to be most conuenient, for there is such affinity in your English tong betweene the point of the compasse vsed in sailing, and the point of the compasses vsed in making of Circles, and other Geometrical descriptions that many times it breedeth an error: so that whensoever I shall haue occasion to speake of any line of direction, I thinke it best to call it a Rhombe.

P. What vse haue they in the terrestriall globe?

M. Their vse is manifold, as I will teach you by several propositions whereof this shalbe the first, because it is most generall, and chiefly respecteth these lines: any places, or points being assigned in the terrestriall globe, find their rhombe, that is, vpon what point of the compasse

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passé I am to direct my course frō the one vnto the other.

P. Thē as it should seeme by your words, these spiral & winding lines, which you call the rhombes, do imitate the winding nature of the Mariners compasse.

M. They doe so, for if you marke them, they make alwayes one & the same angle with the meridian of any place, & doe run on by little & little as the very nature of the compasse would direct you, if you should follow any one point thereof. In these rhombes you may note this, that the rhombe of north or south is alwaies some meridian or other, but the line of East, & west is parallell alwaies to the equator, whereby you may perceiue that to be true, which I told you before, that it is one thing for a place to lie or coast East & west from you, but it is another thing to direct your course East & west, for hee that directeth his course according to the Rhombe of East & west neuer altereth his latitude, but keepeth alwayes in one distance from the equator, whereas hee which runneth continually vpon a greate circle must of necessity at length make an interseccion with the equator. The other Rhombes trauesse the globe more or lesse according as they come nearer vnto, or are further off frō the meridia. Let vs return to the proposition propounded.

P. Go to then, two places being propounded, how shall I finde vppon what Rhombe I am to direct my course?

M. Take your Quadrant of Altitude, or some other Brasen ruler bowed according to the circumference of the Globe, lay it precisely vpon the two places assigned, & marke where it cutteth any 2. circles of latitude on the globe, set one foot of your cōpasses in the one interseccio, extend the other foot vnto the other interseccio

M a

then

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then come downe vnto the equator, and wherefoeuer you see these rhombes to meet together (we cal it commonly the center of the flye or rose) there set the foot of your compasse & extend the other compasse to the next circle of latitude to the equator, the Rhōbe, vpon which the foot of your compasse doth light, will giue you your direction.

P. I must needs trouble you with certaine questions, because this matter is very strange vnto me. When I set the one foot of my compasse in the cētre of the flye is it not materiall, which way I turne the other foot either vpward, or downward to the right hand, or to the left.

M. As for turning your compasses vpward to the parallell next aboue, or downward to the parallell next beneath the equator, it is not greatly materiall, yet you must consider this, that if you turne your compasses vpward to the parallell the centre of the flye doth represent the nethermost place of the two, if you turne it downward it representeth the vppermost. As for turning your compasse to the right or to the left hand you must take especial care of that: this rule you must obserue that your compasses must alwaies imitate the situation of your ruler that if the vpper end of your ruler bende to the right hand or to the left, the vpper foot of your compasse must doe the like, and this must be your continuall prouiso, that the feet of your compasses touch the two paralleles exactly.

P. But I perceauē this, that albeit the compasse light vpon the parallell, yet it will not alwayes light vpon a Rhombe.

M. That is true, if it light vpon a rhombe, then you

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our direction from place to place precisely according to the denomination of the Rhombe: As for example, if light (being turned vpward) vpon the the third Rhóbe, from the meridian to the right hand, then must your direction be from the nethermost place vpward Northward, and by North. But from the vppermost place downward it is Southwest & by South.

P. Doth one and the same line geue me alwaies two directions.

M. Yea, according as you mooue from one place to another, if you bend your course vnder the meridian from the North pole to the South, then is your direction southward, but from the South pole vpward it is North, though the line of direction, that is, the Rhombe be all one, so likewise descending, one and the same Rhombe is Southwest, which in ascending is Northward.

P. If the foote of my compasse lighting vpon the parallel doth not exactly touch any Rhombe, what shall I then?

M. Marke vnto which Rhombe the compasses come nearest, let that giue the denomination to your direction, adding these wordes, and a litle more, or a quarter of a point more, to the Eastward or to the Northward, as falleth out.

P. Yet there ariseth another doubt: in searching the Rhombe betweene Trinidada, and Cape verde and laying my ruler vpon them as you willed me, I perceau the imperfections of it, and the parallels to fall out so far a vnder, that my compasses cannot conueniently reach them. In this case, what shall I doe for to fynde the Rhombe?

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M. You must vnderstand, that so longe as you canne reach the interseptions of the Parallels, with your Compasses, that rule which I haue set downe is most ready for vse, otherwise let this serue your turne which doth insue. When the landes assigned beare neare vnto the East & West, or vpon any other Rhombe, with a blacke leade applyed close vnto the meridian, from the places assigned describe two obscure parallels of a sufficient length, then with your compasses take the distance of the one land from the other, and guiding your compasses continually vpon the two parallels, see which of the Rhombes contained betweene them will best agree, or come nearest vnto the extention of their feete, that is the Rhombe of your direction. As for example, being desirous to know the Rhombe, which is to direct me from Cape D'al Cuer on the Coast of Maroco, to the Southermost side of the Ilande of Coruo, from the sayd places I describe parallels, then taking the distances of those places, I guide the feete of my compasses vpon the parallels, to the westward: but I finde that they will not exactly agree with any of the Rhombes, but that which cometh nearest vnto them is the Rhombe of North West and by West, which must bee my direction, sauing that I must be somewhat lesse than halfe a pointe vnto the Westward.

P. I must confesse this to bee an exact way, but feareth me with the hurt of my globe by making so many parallels on it.

M. Then take this rule, whereby you shall not hurt your globe. Suppose alwayes that one of the places assigned, wheresoeuer they bee were the centre

Terrestriall Globe.

of the Flie described vppon the Equinoctiall line, then
with our payre of Compasses take the distaunce of
the two places as they lie on the Globe, and with
another payre take the difference of their Latitude.
Sette the one Compasse in the Centre of the Flye,
and guide the other as you see occasion ether East-
ward or Westward, vppon the Equator from the said
Centre vntill the two compasses doe concurre, the
rhombe next vnto the Feete of the Compasses mee-
ing togeather, is the direction which you seeke for.
Thus much concerning the finding of the Rhombe,
whereby you are to direct your course from place to
place: Nowe learne another Proposition, which is
this, the Rhombe being giuen, and the latitude to
finde the place wherewith you fall, or wherein you are:
the which proportion is performed in this maner. Seeke
the rhombe vpon the globe, vppon which you directed
your course, in it (by the helpe of the meridian) mark the
latitude of the place from whence you come: and the la-
titude also of the place with which you fell: take the di-
staunce of those two markes made in the Rhombe: then
setting one foote of your compasses in the place from
whence you came, turne the globe to & froe toward the
meridian, vntill the other foote light vnder the meridian
pon that degree of latitude with which you fell, that is
the place wherein you are. As for example, put case I put
off from the Lizarde Southwest, and came vnto the
fortie degree of latitude, in the Rhombe of South-
west I note the latitude of the Lizarde, and the for-
tie degree also of Latitude, I take the distaunce of
those two markes, & setting the one foot of my com-
passes in the Lizarde I turne the other foot to the fortie
degree

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degree of latitude, whereby I perceave I am wide
the Coast of Portingall vnto the Westward thirte
leagues.

P. I vnderstand you well: now tell me, how shall
finde how many leagues I haue runne vppon the
Rhombe?

M. The second marke being made in the rhomb
assigned as you were taught euen now, take with your
compasse one degree of the equator or of the meridian
which according to our account is 20. leagues, and ac-
cording to the Spanish account 17. $\frac{1}{2}$. measure there
with the portion of the Rhombe contained betweene the
two markes, so shall you finde the distance which you
haue runne.

P. Before you taught mee to take the distance of
two places assigned otherwise.

M. You say true, for then you sought not the
distance according to the course which you did runne,
according to the great circle imagined to be drawne
betweene them: which kinde of measuring, if it should
be obserued in your course you should greatly deceaue
your selfe, as you may perceave in this example, put
you runne vnder the 60. parallell ether East or West,
till you passed halfe thereof, taking your distance as you
were taught at the first in a great circle the two places
can be but 1200 leagues asunder: but your distance be-
ing taken according to your course as I taught you
now amounteth vnto 1800. leagues. Therefore the
way is this, especially if your course made vppon the
rhombe fall out to be great.

P. Let this be the fourth proposition concerning
Rhombes, the Rhombe being giuen, and the distance

knowne

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knownen to finde the latitude, with which I fall, how shal
doe this?

M. In the Rhombe geuen, make a pricke according
to the latitude of the place from whence you departed,
from that pricke, counte the distance, which you haue
runne, at the end thereof make a note bring that note
to the meridian, the degree of the meridian expresseth
the latitude, which you seeke for.

P. May I not also make this conclusion vpon the
globe, the rhombe being giuen, and the distance to finde
how far I am parted from my meridian.

M. Yes most readily: in the Rhombe giuen the la-
titude of the place being noted from whence you depar-
ted, and the course also which you haue runne, bring
the first marke vnto the meridian of the globe, fixe the
globe that it may not stirre, then setting the one foote of
your compasses in the second marke, take the shortest
attention betweene it, and the meridian, the degrees of
the equator contained betweene the feete of your com-
passes being couerted into leagues, or miles wil giue you
the distance from the meridian, from whence you de-
parted.

P. Me thinketh this rule may leade me to the longi-
tude,

M. So it will, for the Rhombe being geuen, and the
place or els the latitude wherewith you fall, it is an easie
matter to finde the longitude according to your globe:
the markes being made in the rhombe as you were
ought euen now, bring the marke which representeth
the place from whence you departed vnto the meridian,
and note in what place it cutteth the equator, bring also
the second marke vnto the meridian, and note in what
place

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place the equator is cutte, the degrees of the Equator intercepted betweene those markes expresse the longitude betweene the two places.

P. There is yet another question to be answered. I runne vpon any Rhombe may I not know how many leagues I haue runne hauing raised, or let the pole fall a degree?

M. Yes that you may, and you may also finde this how farre you are distant from your meridian. Here note this, that in the performance of these conclusions without any great error you may reckon five or ten degrees of the meridian to be but as one, yet with this caveat, that if you count five degrees as one, euery degree is twelue minutes or miles, if ten be taken for one, then is euery degree sixe minutes or miles, but it is best not to exceede five or tenne. To answer therefore to the first of these two questions: come to the Centre of the Flye, which is in the equator, and counte the tenth degrees of the meridian ether next above, or next beneath it to be but as one, and euery degree to be five miles, or two Leagues: then if you measure from the Centre of the Flye vnto the interiection, which any Rhombe maketh with the tenth circle of latitude you shall readily, and easily finde how many leagues or miles you runne vpon any Rhombe, in raising or letting fall the pole a degree. Again if from the first Intersections of the Rhombe, and the Parallell, you measure the distaunce vnto the Meridian, accounting as you did before each degree to be but sixe miles or leagues, you shall finde the distance from the meridian. Is there any thing els which you desire concerning the vse of the Rhombes.

Terrestriall Globe.

P. Yea there is one thing, which hath troubled me most of all, & that is the trauerfing vppon the globe : as thus, sometimes I runne South about 60. leagues, sometimes South Southwest as many leagues, then South and by East 100. leagues, then after that Southwest I know not how farre, but I finde my selfe to bee in four degrees of latitude Southward. How shall I obserue this course vpon the Globe ?

M. If you were perfect in that which I haue taught you, you would not make a doubt of this : but for so much as you are but yet a nouice herein, I will exemplifie the matter vnto you, that by this one example you may gather what you haue to doe in the rest. The example shall be that which you haue propounded, supposing the place from whence wee set sayle to be the Southermost side of cape de verde, at that place where the tenth meridian or circle of longitude toucheth the land. First therefore in that meridian I count 60. leagues, which are 11. degrees where I make a mark, whereby I find my selfe to be in 11. degrees of latitude, and vnder the same meridian : from thence you ranne according to your supposition 60. leagues : from the marke which I made in the 10. circle of longitude I draw with a blacke leade an obscure parallell, which shall cut the Rhombe of South Southwest, in that Rhombe I account 60. leagues (which are three degrees) as I did before, and from thence presently toward the Cape I draw a parallell to the equator, then taking with my compasses the 60. leagues noted in the Rhombe of South Southwest, I set the one foote of my compasses in the marke made in the 10. circle of longitude, & stretch the other foote westward to the parallell which was last drawen, and there make a marke.

Here

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Here I finde my selfe to be almost in the eight degree of latitude, and from the place of my departure a little more than sixe score leagues, and from the meridian thirtie leagues. Afterward you suppose your course to be South and by East an hundred leagues: continuing the last parallell vnto that Rhombe I count in it an hundred leagues: making a marke therein as I did before, and frō it also drawing a parallell line toward the cape, then my compasse being extended to an hundred leagues I set the one foot in the marke made in the former parallell, and turne the other Eastwards according to my direction vntill I touch this last parallel which was described, there also I make a pricke: your last course was Southwest, you know not how farre, but you found your selfe to be in foure degrees of South latitude: I bring the meridian to the rhombe of Southwest, and there make a note vnder the fourth degree of latitude, and from thence I draw another parallell toward the Cape: then taking as much of the Rhombe of Southwest as was contained between these parallell lines, I set the one foote of my compasse in the marke which was last made, and extend the other foote to the last parallell, making a marke therein, which is the place of my being: and thereby I gather that I am fallen to the Southward of the line foure degrees, & am distant from cape verde 390 leagues, and from the meridian from whence I departed 140. Thus much concerning the vse of the rhombes described vpon the terrestriall globe. There remaine now *Philomathes* none of the circles of the Globe to be spoken of but the lesser circles onely, which are the limites of the five Zones, whereof mention was made in the ende of the celestial Globe. The vse of the which circles in the terrestriall Globe is

Terrestrial Globe.

no more than this, to signify what inhabitants of the earth, doe dwell in euerie Zone, and who they bee which feelee that distemperature, or temperature of heate and cold. Whereby you may perceau how greatly they erred, which though the temperate Zones onely to be habitable, and the other by meanes of their extremitie of heate and cold to be vnhabited.

P. Concerning the qualities of the 5. Zones I would gladly be resolued in those questions, first whether each part of the burning Zone be of a like heate: and if they be not, which is the hottest. Secondly, whether the other Zones bee of a likely condition, or if they bee not, which exceedeth one another in their qualities.

M. I will willingly satisfy your desire, and that so much the rather because some of the argumentes vsed in deciding those questions may be expressed on the globe. You must here note what be the efficient causes of the heate and cold: the causes which produce these effectes are counted 3. First the heat is caused by the perpendicularity. Secondly, the long abode. Thirdly, the nearness of the Sunne. The cold therefore must be effected by the obliquitie, by the small abode and by the elongation of the sunne. This also standeth with reason, that where there are most causes there must be the greatest heate or cold. Let vs therefore examin them in the Zones, beginning first with the burning Zone. For so much as the burning Zone is contained within the Tropickes, so many therefore as inhabit that Zone must of necessity haue the sunne perpendicular vnto them, so that in that respect, they are all equall, though in the other causes they differ. The abode of the Sunne is lesser vnder the Equator than vnder the tropickes, for the day is but of 12. houres

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houres vnder the equator but vnder the tropickes it is 13. $\frac{1}{2}$. and somewhat more. Moreover the Sunne comming toward the Equator, and departing from it, declineth almost in one moneth so much as he doth in moneths, neere to the tropickes: Last of all, the Sunne comming toward the equator, keepeth on his course directly, not comming that way agayne till halfe a year be past, but comming toward the tropickes as he heate the earth mightily by his slow ascending, so doth he encrease the heat by his slow descending, and his sodaine returne. The heate therefore neare vnto the tropickes is greater than vnder the equator.

P. Then which is the hotter of the two tropickes?

M. The tropicke of Capricorne, for it hath not only the Sunne perpendicular and continuing a long time about the horizon, as the other tropicke hath, But the Sunne being in that tropicke, is nearer the earth, hereafter you your selfe will confesse according as you goe one forward in these studies. Hereupon the second question may bee resolved, that of the two zones the antarcticke is the colder, and in the temperate zones the winter is colder to the Southward than to the Northward: for albeit hee bee oblique to both, and continue a like time about either of their horizons: yet for so much, as in Winter hee is neerer them that dwell in the Northren zones, than to them that dwell in the Southern zones: they therefore have the warmer Winter, and consequently the colder Summer. Having now answered your questions, it remaineth *Philomathes* to aduise you to acquaint your selfe thoroughly with your globe, not onely that you may be readie to perform those conclusions, which you have

Terreſtriall Globe.

learned, but alſo that you may know, and diſtinguiſh the ſeueral partes of the world with the chiefe Kingdomes, Cities, Capes, neckes of land, Seas, Streights, and Rivers throughout the whole world, for it will be vnto you a great diſgrace, eſpecially in this our trauelling age, not to be cunning in theſe thinges: which cunning you may eaſily attaine vnto, if you doe but furniſh your ſtudie with the Globes, and now and then as your leaſure ſereth, looke vpon them.

P. I will doe mine indeuor, eſpecially, becauſe as I haue a good hope of the profite that may enſue, ſo I finde pleaſure to be exceeding great. And to you ſir for the paines which you haue taken in furthering my ſtudy, I ſhal thinke my ſelfe greatly beholding ſo longe as I liue.

M. That is my deſire *Philomathes*, to make young ſtudents to be beholding vnto me, & if ſo be hereafter you ſhall ſtand in need of my helpe, ether through forgetfulnes or hardnes of that, which I haue taught, you, if you will repaire to my poore lodging in Abchurch lane, you ſhall find me ready to doe you what pleaſure I can.

And ſo farewell.

FINIS.

